Water Works and Sewerage

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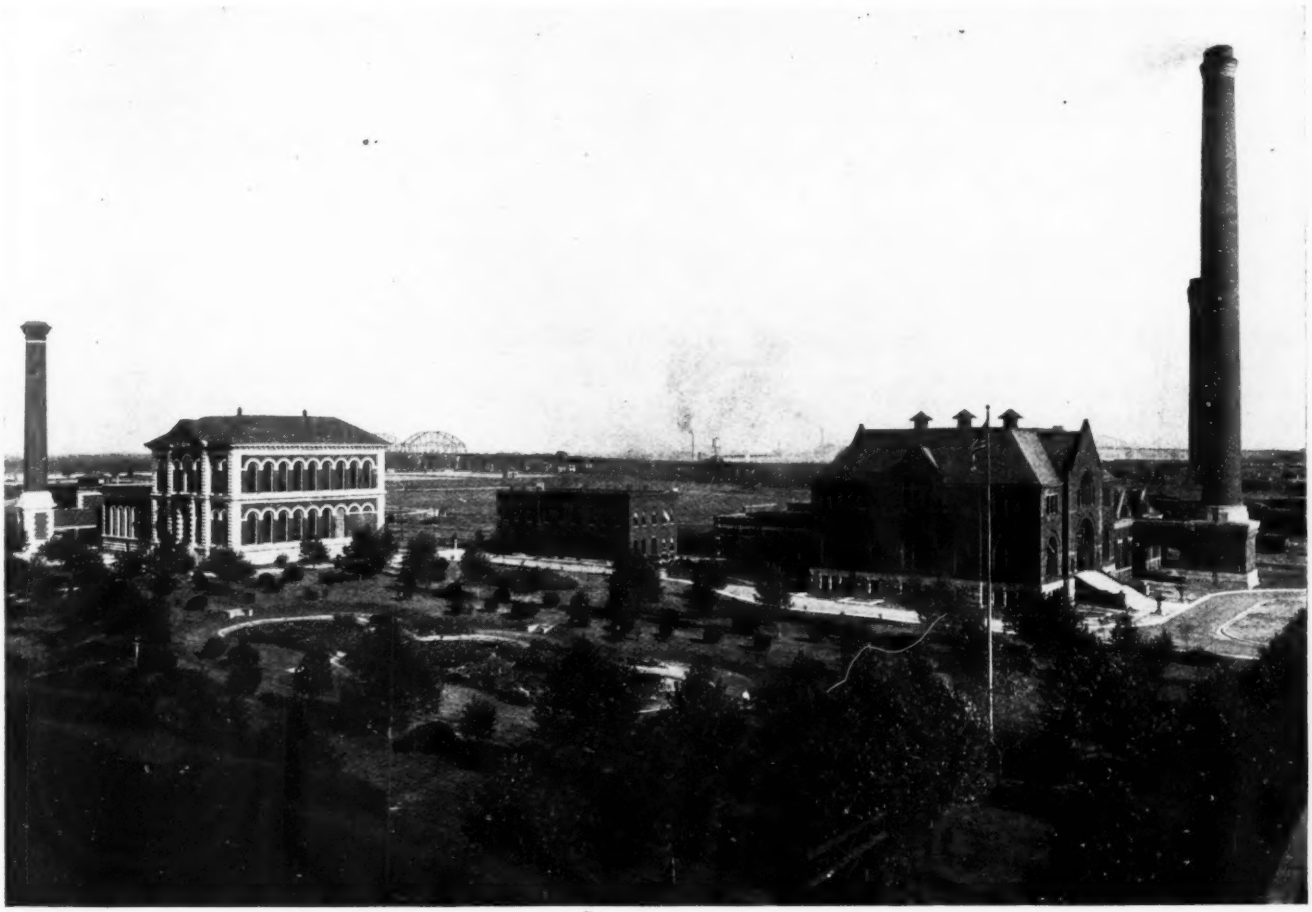


The Bissell Point Station of the St. Louis Water Works

The Water Works of St. Louis, Mo.

City Has Two Independent Sources of Supply and Two Separate and Interconnecting Distribution Systems

ST. LOUIS obtains its water from the Mississippi and Missouri Rivers by means of two independent sources of supply and two separate and interconnecting systems of distribution.

The sources of supply are named after their respective locations on the two rivers—"Chain of Rocks" on the Mississippi and "Howard Bend" on the Missouri. The two distribution systems are named after their respective reservoirs—"Compton Hill" and "Stacy Park."

Each source of supply has complete low pressure pumping and purification plants. Howard Bend Station, in addition, has its own high pressure pumping plant, but this function is performed for the Chain of Rocks Station by the high pressure stations located at Baden and Bissell's Point, a distance of 4 miles and 7¾ miles, respectively, from the Chain of Rocks.

The Compton Hill distribution system serves the lower parts of the city, lying mostly east of Grand Boulevard, and is supplied by the Bissell's Point Station.

The Stacy Park distribution system serves the high districts lying mostly west of Grand Boulevard, and is supplied by the Howard Bend and Baden Stations.

These systems are interconnecting so that the Stacy Park system can be made to supply the Compton Hill system if necessary.

The Chain of Rocks Station is complete as far as capacity is concerned. Any future increase occasioned by growing demand will be supplied by the Howard Bend Station, which is so designed and constructed that additional units for increasing the capacity may be added to any part of the plant without interfering with its operation.

Chain of Rocks Station.—At the Chain of Rocks Station the muddy river water is drawn from the Mississippi River through one or more of three intake towers, two of which are located in the channel and one at the shore. From these intakes the water passes through tunnels in solid rock under the river to the wet well, from which it is drawn by the low pressure pumps. The low pressure pumps raise the water an average of 40 ft. to the delivery well. From this point it flows entirely by gravity through the remainder of the

Chain of Rocks Coagulant House

plant and to the storage basins at Baden and Bissell's Point Stations, a distance of 4 miles and 7¾ miles, respectively.

From the delivery well the water passes through the grit chamber where sand and heavy sediment is removed, then to the lime mixing conduit, at the entrance to which milk of lime prepared in the coagulant house is added. The purpose of the conduit is to thoroughly mix the lime with the raw water, this being accomplished by a travel of 1⅔ miles through this channel.

Upon leaving the mixing conduit and before entering the primary settling basins through the filling conduit, a solution of sulfate of iron, also prepared in the coagulant house, is added. The water is then allowed to remain in the primary settling basins an average time of 34 hours, after which the settled water passes by means of the collecting conduit through two venturi meters into a secondary coagulation basin. At this point a solution of sulfate of alumina is added and also a preliminary dose of chlorine applied.

From the secondary coagulation basin the water flows through two secondary settling basins and then through the rapid sand filters to the drawing conduit chamber. Here it is again sterilized with chlorine before entering the delivery conduits which conduct it to the high pressure pumping stations at Baden and Bissell's Point.

At the Baden Station, four miles south of the Chain of Rocks Station, part of the water enters a covered storage reservoir, from which it is taken by the pumps and delivered into the Stacy Park distributing system. The two main delivery conduits continue on 3¾ miles to Bissell's Point Station, where the balance of the water enters the covered storage reservoirs, from which it is pumped into the Compton Hill distribution system.

The pumping equipment at the Chain of Rocks Station consists of four Allis-Chalmers vertical compound engines, each having a capacity of 35,000,000 gal. per 24 hours and three DeLaval steam turbine-driven centrifugal pumps, two having a capacity of 35,000,000 gal. and one a capacity of 110,000,000 gal. per 24 hours.

East Intake Tower, Chain of Rocks

The Baden Station is equipped with six Allis-Chalmers triple expansion high duty pumps having a total capacity of 80,000,000 gal. per 24 hours.

The Bissell's Point Station pumping equipment consists of three Allis-Chalmers and three Holly vertical triple expansion high duty pumps, and one Cameron steam turbine-driven two-stage centrifugal pump, each with a capacity of 20,000,000 gal. per 24 hours, giving the station a combined pumping capacity of 140,000,000 gal. per 24 hours.

Howard Bend Station.—The Howard Bend Station recently completed at a cost of $12,000,000, provided from bond issue funds, is at present a complete system, producing and delivering to the city mains each day, 55,000,000 gal. of pure drinking water. It comprises a shore intake, equipped with traveling screens, and standing just off the deep channel of the Missouri River, the channel having been brought into its present location, and confined there, by an elaborate system of hurdle dikes and revetment work; a low service pump pit and house built integral with the intake; a high pressure pump pit and house, the house adjoining the low pressure house and the pits connected by a tunnel; a boiler house connected by an inclined belt conveyor to a coal receiving and crushing station; a chimney 275 ft. high, housing in its base

Howard Bend High Pressure Pumps

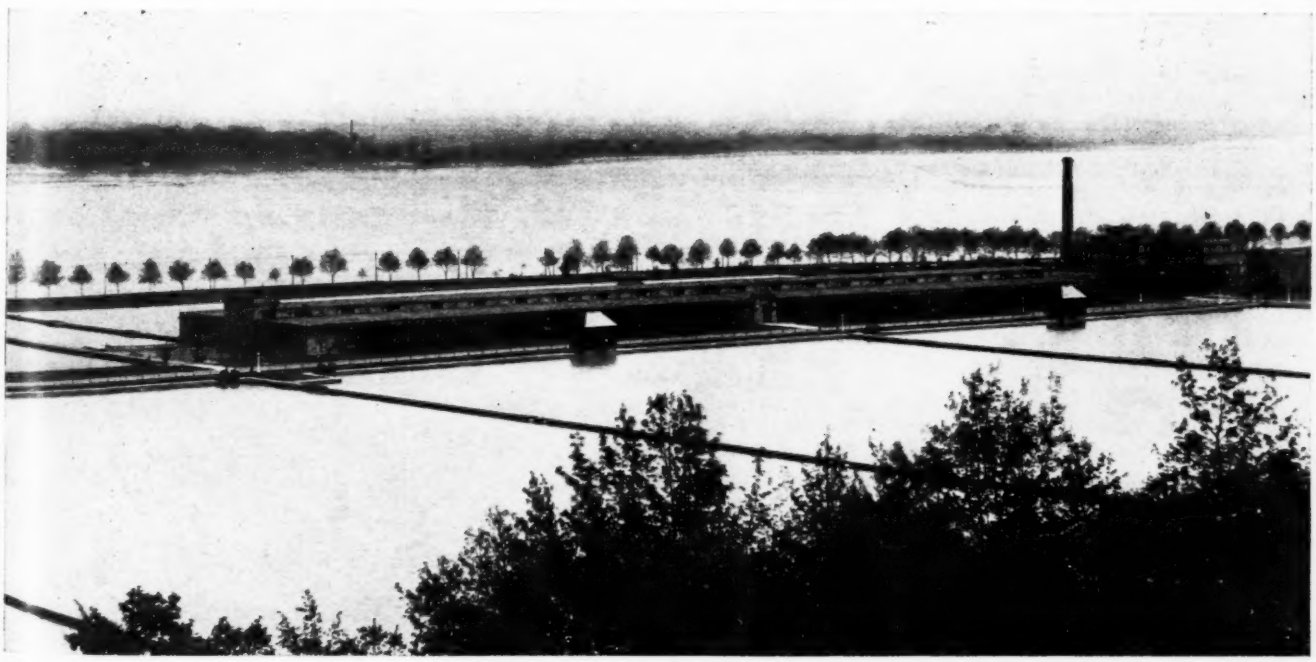
Howard Bend Filter Plant

a carbon-dioxide plant; four settling basins, each 150 ft. square, provided with mechanical scrapers for continuously removing the accumulating sludge; two sludge pump houses; a coagulant house equipped with pneumatic equipment for unloading and conveying chemicals and for the storage of chemicals and their preparation for admixture with the water; mixing conduits and reaction chambers; two large sedimentation basins; a carbonating chamber; filter plant; head house and chemical laboratory; covered clear water basin; and the 100,000,000 gal. covered storage reservoir at Stacy Park, with 16.4 miles of 62-in. steel pipe line to convey the purified water from the high pressure pumps to it and thence to the city mains.

At the Howard Bend Station the raw water is drawn from the Missouri River through the shore intake and passes through vertical traveling refuse screens that remove all sticks, leaves, etc., before passing to the low pressure pumps which raise the water into the rising well, an average lift of 33 ft. From this point the flow through the purification system to the high pressure pumps is entirely by gravity.

West Intake Tower, Chain of Rocks

From the rising well the water flows to two preliminary sedimentation basins where 50 to 95 per cent of the suspended mud and sand are removed by natural sedimentation. These basins are equipped with revolving scrapers for the continuous removal of the deposited mud and sand. The water then flows through a rapid mixing conduit where milk of lime, prepared in the coagulant house, is added and thoroughly mixed with the water before it passes into four circular reaction chambers where sulfate of iron, also prepared in the coagulant house, is added. Thirty



Chain of Rocks Filter Plant

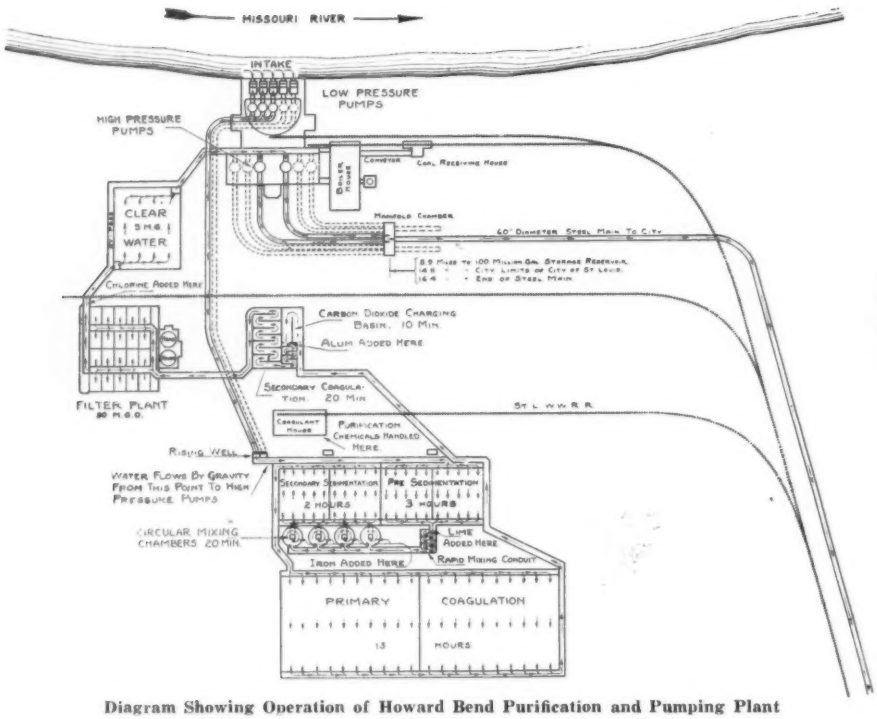


Diagram Showing Operation of Howard Bend Purification and Pumping Plant

minutes' gentle agitation is given the water in the reaction chambers before it is allowed to go into the two coagulation basins, where most of the lime and magnesia precipitated from the water by the chemicals added is removed together with the fine suspended matter not settled out in the preliminary sedimentation basins.

These coagulation basins are also equipped with revolving scrapers for the continuous removal of mud or coagulated sludge. This sludge is usually pumped back into the muddy river water before it enters the preliminary sedimentation basins, as it has been found to greatly accelerate the rate of settling.

The water then flows to the two large sedimentation basins where practically all of the suspended matter not removed by previous treatment settles out. From these basins the water flows to the carbonating basin where it absorbs carbon dioxide from washed flue gas which is bubbled through it. After leaving the carbonating basin the water receives a charge of sulfate of alumina and passes through another rapid mixing conduit into the secondary coagulation basin, from which it flows to the filters.

After being filtered the water receives a small charge of chlorine, then flows into the underground clear water basin from which it is taken by the high pressure pumps and pumped through a 62-in. steel conduit to the 100,000,000 gal. Stacy Park storage reservoir, a distance of 8.9 miles. From this storage reservoir the water flows by gravity to the city through a 62-in. conduit, a distance of 7.5 miles, entering the city mains along Oakland Ave. at various points between Skinker Boulevard and Kings highway.

The pumping equipment at Howard Bend Station consists of three DeLaval centrifugal low pressure pumps delivering river water to the settling basins and two DeLaval centrifugal high pressure pumps, delivering purified water to Stacy Park reservoir, all being driven by steam turbines. Two of the low pressure pumps have a capacity of 60,000,000 gal. each and one a capacity of 120,000,000 gal. per 24 hours, against a dynamic head of 40 ft. Each of the two high pressure pumps have a capacity of 60,000,000 gal. per 24 hours, against a dynamic head of 360 ft.

Purification Process.—The process of purification is partly mechanical and partly chemical. Screens are used to remove sticks, leaves, pebbles, fish, etc.; large particles of suspended matter such as sand and heavy silt are removed in a grit chamber or preliminary sedimentation basins.

Lime is added to soften the water, or reduce its hardness, and to act as a coagulant, while sulfate of iron is added to assist in the proper coagulation.

Sulfate of alumina is added as a secondary coagulant to prepare the water for filtration.

The several reaction chambers or mixing conduits are for the purpose of facilitating coagulation by giving the water a gentle agitation for 20 to 30 minutes.

The filters remove the small amount of suspended matter which has defied sedimentation, and most of the bacteria which have escaped previous treatments.

Chlorine is added to destroy any bacteria which may escape the filters.

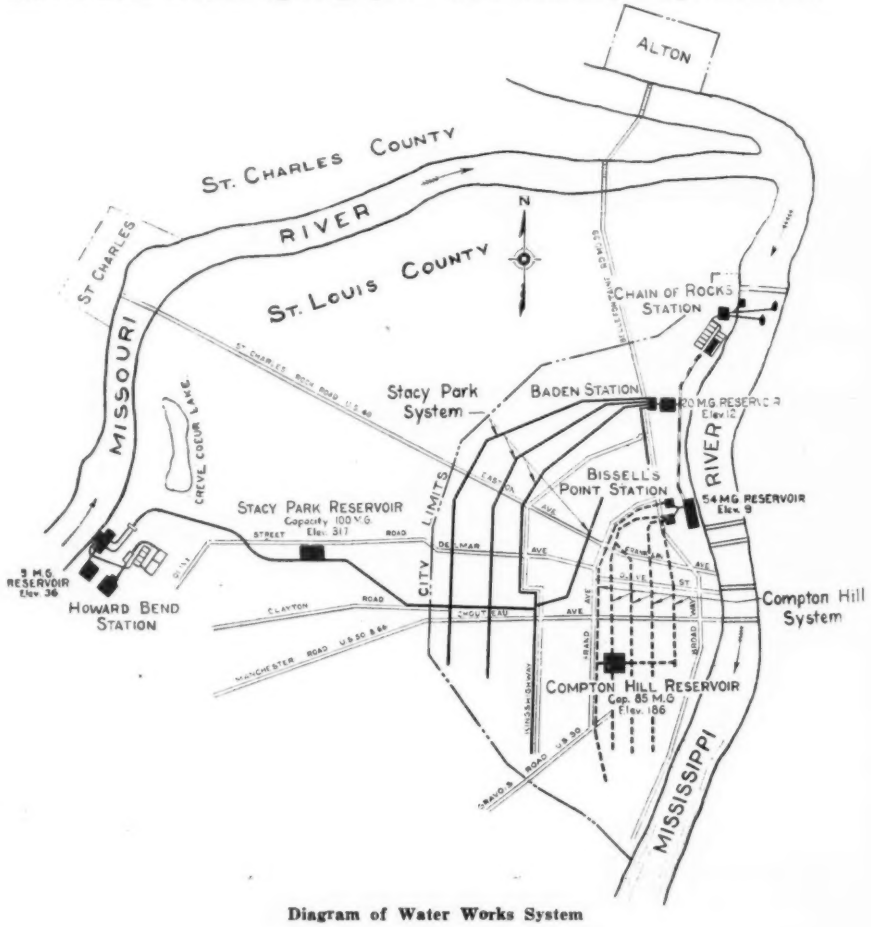


Diagram of Water Works System

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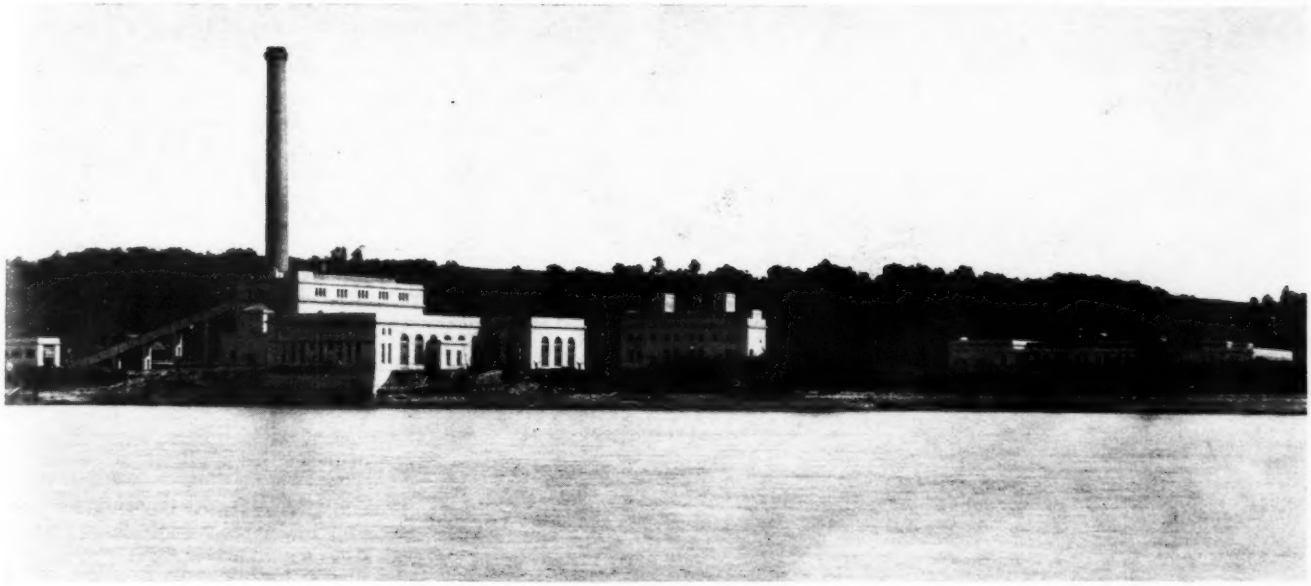


General View of Howard Bend Station

At the Howard Bend plant carbon dioxide is added ahead of the alum whereby the amount of this chemical required is reduced. The coating of filter sand with lime salts and the encrusting of distribution mains, meters, etc., is prevented to a large extent by this carbonation treatment.

Results of Purification.—The average results of the purification process are:

(a) A reduction in hardness from 189 to 103 parts per million, thereby effecting a saving in soap cost to the consumers of $1.72 for every 1,000 gal. of water used for washing and bathing purposes.

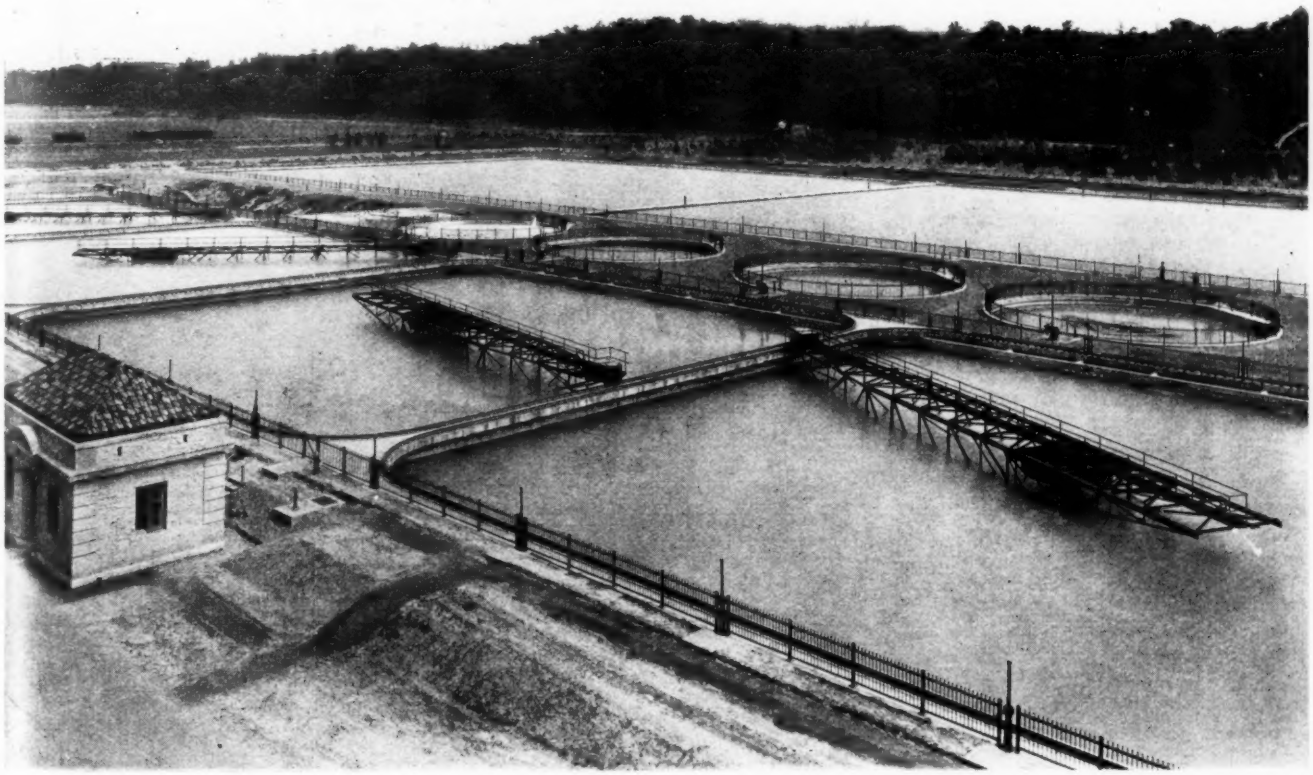
(b) A reduction in scale forming compounds from 1.59 lb. to 0.81 lb. per 1,000 gal. of water, thereby effecting a saving in fuel where water is used for boiler purposes.

(c) The complete elimination of all harmful bacteria with an attendant reduction in the number of cases of water borne diseases, especially typhoid.

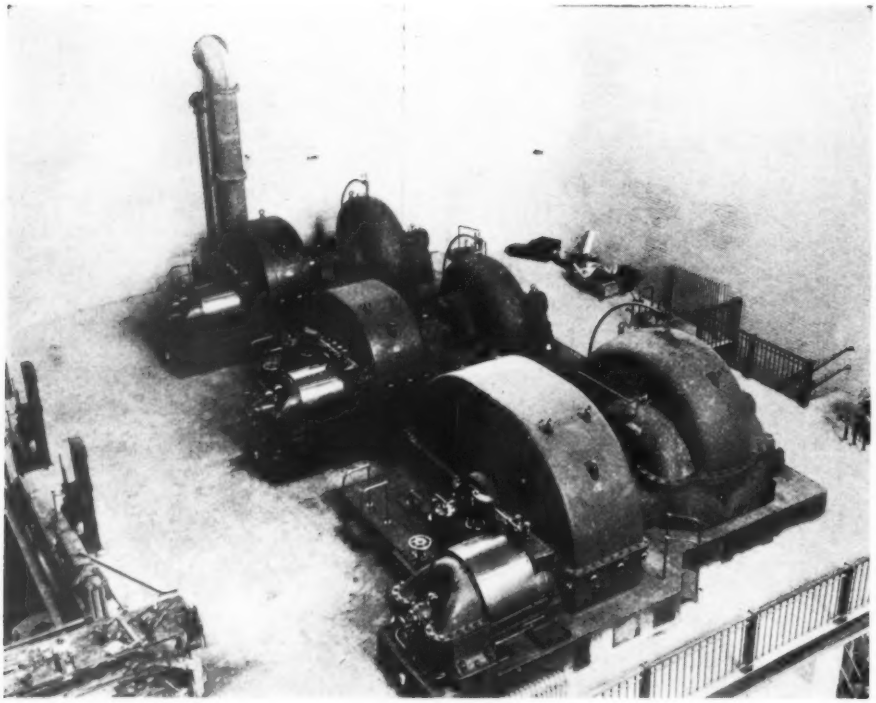
(d) A reduction in color from 17 to 9 parts per million and a reduction in suspended solids from 1,250 to zero parts per million, thereby producing a clear and sparkling water.

(e) A complete removal of all odors and objectionable tastes.

The Distribution System.—The distribution system within the city limits consists of 1,136 miles of pipe, in sizes ranging from 6 in. to 48 in. in diam-



Howard Bend Basins



Howard Bend Low Pressure Pumps

eter. All of this pipe, with the exception of five miles of 36-in. steel pipe, is cast iron.

All service pipes must be either lead, copper or cast iron, and are installed and maintained at the expense of the property owner.

There are 146,895 service connections, of which 12,603 are metered. While the number of metered service connections represent only 8.6 per cent of the total number, the amount of water used through these connections amounts to approximately 50 per cent of the total water consumption of the city.

There are four service stations located in eastern, western, southern and northern parts of the city, at which a sufficient number of men are kept to take care of the repairs and maintenance of the distribution system.

A force of 30 inspectors is busy investigating complaints and inspecting plumbing fixtures and trying to eliminate water waste, and four men are checking meters to see that they are registering accurately.

All pipe is laid by Water Division forces. The Distributing Section of the Water Division is equipped with four trenching machines, two cranes, three air compressors, 31 trucks and 27 automobiles which are used for the maintenance and extensions of the distribution system.

Transportation.—As a necessary adjunct to the foregoing equipment, the Water Division owns and operates a combined steam and electric railway, about 7¾ miles long, extending from Bissell's Point to the Chain of Rocks. This railway handles all coal and supplies for the Bissell's Point, Baden and Chain of Rocks Stations and carries employes to the Chain of Rocks. Employes are transported from the city to the Howard Bend Station by means of large automobile busses, and all coal and supplies for the station are handled from the Rock Island Railway with gasoline locomotives.

Water Works Parks.—All land around the several stations and reservoirs is being made into beautiful parks. This land consists of 300 acres at the Chain of Rocks, including 3½ miles of river front; 44 acres at Baden Station; 98 acres at Bissell's Point, with one-half mile of river frontage; 40 acres at Compton Hill reservoir; 53 acres at Stacy Park reservoir; and 240 acres at Howard Bend Station, including ¾ mile of river frontage and 46 acres on the bluff between the station and Olive Street Road. This constitutes a total area of 775 acres.

Plants and trees for landscaping these grounds are grown in the Water Division nursery and greenhouses.

The Chain of Rocks Park is a naturally wooded hillside overlooking the station affording an unusual view of an extensive reach of the Mississippi River, the nearby Illinois towns and the distant city. This park is very popular with the public as a place for picnics and recreation.

The Bissell's Point Park is now in course of development. It fronts upon the Mississippi River, surrounds the Bissell's Point Station and storage basins and contains the Naval Reserve Station.

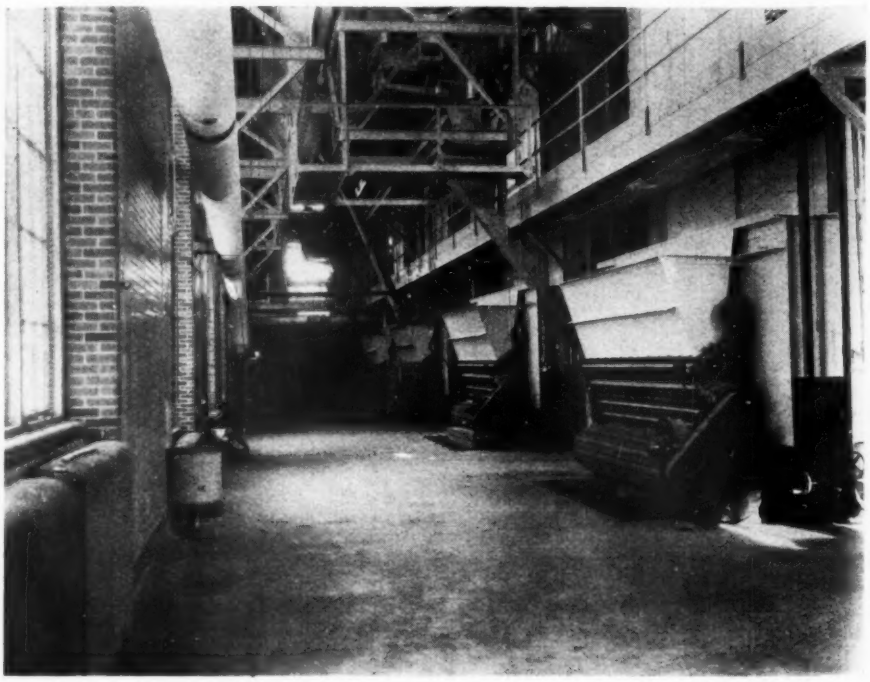
Compton Hill Park surrounds the reservoir in an attractive residential district and is much used by the neighborhood as a recreation place.

Stacy Park, lying about the reservoir of that name, is also in the development stage. Situated upon the highest ground in the vicinity of St. Louis, it affords a panoramic view of the surrounding country for many miles.

The station site at Howard Bend is being developed into a park which is intended to rival the beauty of the one at the Chain of Rocks.

Summary of Statistics.—The following figures are for the year ending April 1, 1930:

Physical value of water works	$45,681,252
Bonded debt	12,082,000



Howard Bend Boiler Room

Storage

In process of purification:	Gal.
Chain of Rocks	295,000,000
Howard Bend	45,000,000
Total	340,000,000
Capacity of filtered water basins:	
For distribution by pumping—	Gal.
Baden storage basin	20,000,000
Bissell's Point storage basins	54,000,000
Howard Bend clear water basin	5,000,000
Total	79,000,000
For ditribution after pumping—	
Compton Hill Reservoir	85,000,000
Stacy Park Reservoir	100,000,000
Total	185,000,00
Total filtered water storage	264,000,000

Consumption of Water

Estimated total population served	900,000
	Gal.
Total consumption for year	44,903,936,000
Maximum daily consumption, June 22, 1929	164,000,000
Minimum daily consumption, May 5, 1929	90,400,000
Average daily consumption	123,024,000
Average per day to each person	137

Pumping Capacity

From River to Settling Basins:

	Mil. Gal Per 24 Hrs.
Chain of Rocks Station	320
Howard Bend Station	240
Total	560
To Distribution System:	
Baden Station	80
Bissell's Point Station	140
Howard Bend Station	120
Total	340

Purification

Type of filters—gravity, mechanical.
Rated capacity:

	Mil. Gal Per 24 Hrs.
Chain of Rocks	160
Howard Bend	80
Total filter capacity	240

Results of Purification

Impurities	Raw Water	Purified Water	Per Cent Reduction
Suspended matter, parts per million	1,250	0	100
Dissolved matter, parts per million	312	227	27
Color, parts per million	17	9	47
Hardness, parts per million	189	103	46

Impurities	Raw Water	Purified Water	Per Cent Reduction
Scale forming solids, pounds per 1,000 gal	1.59	0.81	49
Bacteria, all kinds; number per milliliter	4,200	10	99.76
B. coli; number per 100 milliliters	2,660	0.02	99.999
Pounds of mud removed from each million gallons of water			11,100

Chemical Data

Chemicals used during year:	Tons
Lime	18,771
Iron	2,320
Alum	3,703
Chlorine	82.6

Distribution System

Mains:
Kind of pipe, cast iron and steel
Sizes, from 6-in. to 48-in.—

	Ft.
48-in. pipe	1,341
36-in. pipe	238,493
30-in. pipe	159,691
20-in. pipe	508,077
15-in. pipe	53,559
12-in. pipe	1,065,419
10-in. pipe	49,859
8-in. pipe	227,381
6-in. pipe	3,694,748
	5,998,568 = 1,136.1 miles

Range of pressures in mains, 20 to 25 lb. per sq. in.
Number of fire hydrants (public and private) now in use, 13,859

Service Connections

Kind of pipe, lead, cast iron and copper
Sizes, ⅝ in. to 12 in.

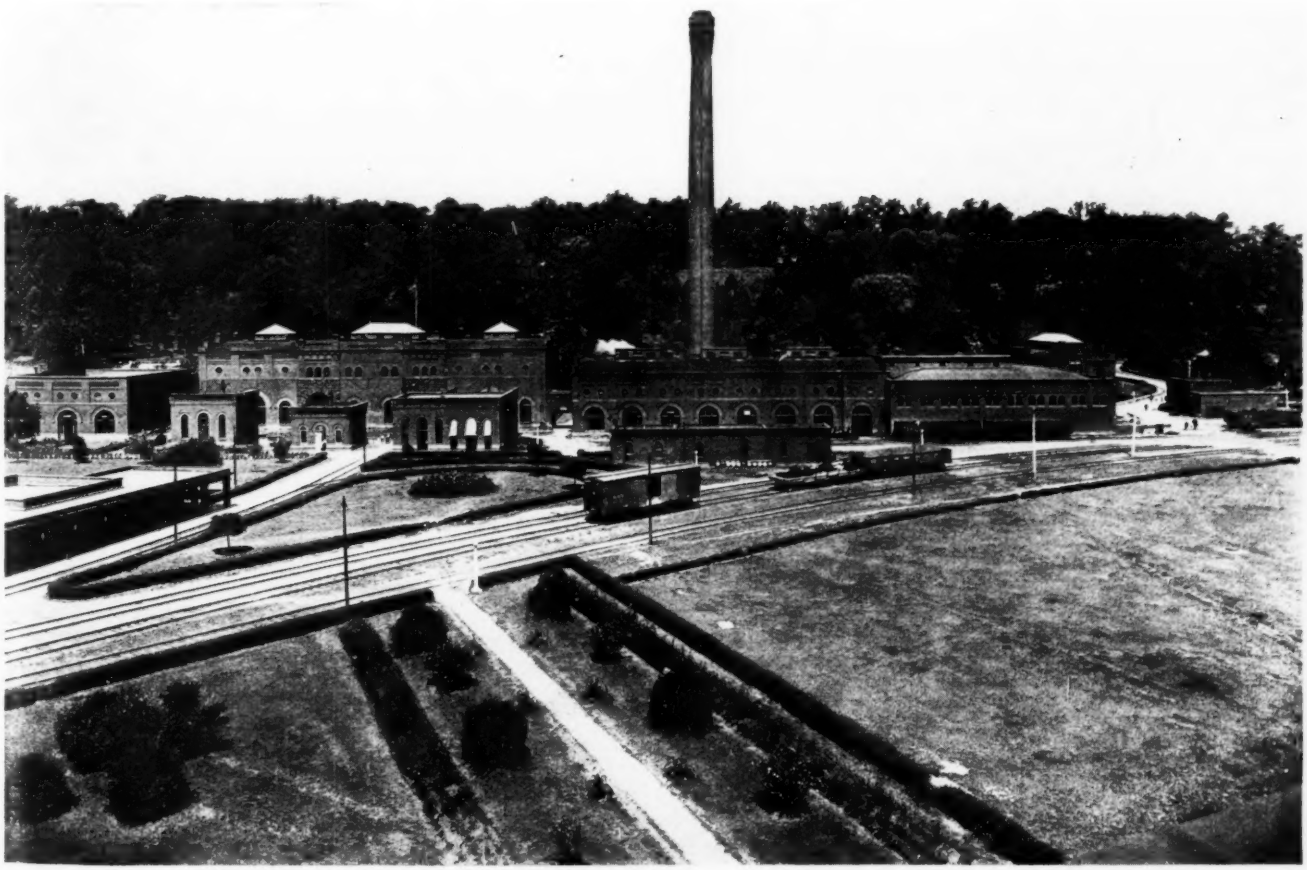
Number of flat rate service connections now in use	134,292
Number of meters now in use	12,603
Total number of connections	146,895

Vital Statistics

	1903	1913	1928	1929
Deaths per 100,000 from all diseases	1,681	1,389	1,420	1,390
Deaths per 100,000 from typhoid	47	17	2.23	1.5

Personnel.—The officials of the city and of the St. Louis Water Works are: Mayor, Victor J. Miller; Comptroller, Louis Nolte; Board of Public Service: Edmund R. Kinsey, President; Robert B. Brooks, Director Street and Sewers; J. L. Rilliet, Jr., Director Public Utilities; Harry L. Salisbury, Director Publice Welfare; Edward A. Steininger, Director Public Safety; Water Commissioner, Leonard A. Day; Engineers in Charge: Supply and Purifying Section, E. E. Easterday; Operating Section, H. Clay Henning; Distribution Section, Thos J. Skinker; Assessment Section, S. O. Schumacher.

State and Municipal Bond Election in April.—According to the "Daily Bond Buyer," bond authorizations reported by 180 communities during April aggregated $45,325,479, the largest total for any of the first four months of the year. The figure for April of last year was $37,963,300; for 1928, $77,465,239, and for 1927, $75,778,049.



Chain of Rocks Pumping Station

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Filtration Engineer, Bureau of Engineering, Chicago, Ill.

Factors Influencing the Toughness of Coagulated Matter

A DISCUSSION of the make-up of the gelatinous precipitates of iron and aluminum, and the way in which such precipitates remove the suspended matter from water was given in the May issue. It was assumed that such precipitates were composed of a meshwork of entangled fibers, such assumption being in accordance with the generally accepted theories as to the formation of many and perhaps most gelatinous precipitates. The fibrous formation is built up from minute solid particles wihch coalesce after neutralization or partial neutralization of the positive electrical charge on the particles. As to what produces the coalescence is not known, but it is known that there is something which holds the solids together when they collide. The present article is a continuation of the discussion on coagulation, and is limited largely to the factors which influence the strength of the flocculated matter formed by the hydrous oxides of aluminum and iron when water is coagulated.

Micro-organisms Cause Short Filter Runs.—Many are aware that there is considerable variation in the strength of the coagulated matter from time to time due to the presence of microörganisms in the water, but we know very little about the causes for variation in the toughness when microörganisms are not present. It is easy to conceive how microörganisms add toughness to the flocculated matter, for it is somewhat like adding steel reinforcing to concrete to make it stronger, but it is not so easy to see how the strength may be affected materially by other factors. When certain forms of organisms are present they may form a mat at the surface of the sand so tough there is practically no penetration of the coagulated matter into the sand beds. This causes the loss of head to increase rapidly and gives very short filter runs. How microörganisms affect the filter runs has been explained.[1] We shall now discuss factors other than microörganisms that influence the toughness or the strength of the precipitates of hydrous oxides of aluminum and iron in coagulating water prior to filtration.

Coagulated Matter Passing Filter Beds.—Most filter operators in localities where the water temperature goes nearly to the freezing point in winter have had difficulty with suspended matter passing the filter beds when they felt that the water was properly coagulated. This is usually called an "after precipitation," or "coagulation after filtration." As a matter of fact in most instances it is merely coagulated matter which has once been formed and flocculated perfectly but is too weak in structure to prevent the larger masses being broken up into a number of finer masses that will pass through the filter beds when a little pressure is exerted on the beds due to the loss of head increasing.

The cause for the formation of the weakly formed flocculation is difficult to determine, unless the gelatinous precipitate is naturally weak and the strength we get in water treatment is due largely to the suspended matter or turbidity in the water. Filter operators frequently express their preference for a water fairly turbid over fairly clear water, and the reason for this may be that the turbid water produces a stronger flocculation. It produces a heavier precipitate that settles clearer than the less turbid water, but in addition to this it seems to give strength to the material that does not settle out before the water reaches the filters.

The writer will give his own observations as to the probable causes for some of the variations in the strength of coagulated matter. In some instances the assumptions seem fairly well supported by experimental data, but in other instances little is known. Figure 1 shows the enormous amount of coagulated matter that will pass through sand beds under conditions of weak coagulation. The volume of the coagulated matter is based upon the volume per million volumes of water; that is, 10 volumes of coagulated matter is 10 gallons of compact flocculated matter per million gallons of water.

Supersaturation of the Hydrous Oxides Reduced Rapidly.—When aluminum sulfate is added to water containing sufficient alkalinity for coagulation to take place, the reaction of the sulfate with the alkali liberates the hydrous oxide of aluminum and produces considerable supersaturation. This causes minute solid particles or crystals to form in large numbers, which quickly reduce the supersaturation nearly to the point where there is no supersaturation. The reduction in supersaturation may be nearly complete before the minute particles have coalesced into chains or fibers. In the formation of crystals from a highly supersaturated solution the number of particles which form all start forming within a very short time, and in some instances within two or three seconds after the formation of the supersaturation. The particles, of course, keep increasing in size so long as the solution is supersaturated, but they do not keep increasing in number.

We have no evidence that the total number of solid particles which form when aluminum sulfate is added to water reaches the maximum within two or three seconds, but the time is quite short. This also applies to the iron compounds used in water treatment. If the saturation point of the hydrous oxide of aluminum or iron is only about 0.2 part per million, and sufficient coagulant is added to produce 4.0 parts per million of the hydrous oxide, then the supersaturation is about 20 times the normal saturation. This is considerable supersaturation and causes the formation of a large number of minute solids very quickly. By the time the solid particles start coalescing into chains the supersaturation is nearly exhausted. This means that after coalescing there is practically no excess of the hydrous oxide to build the chains or fibers larger in diameter. In other words, we cannot count on the fibers that go to make up the gelatinous precipitate getting much stronger than they are when first formed.

Formation of Flocculated Particles.—Explanation was given in the May issue as to how the minute solids of the hydrous oxides became positively charged, how the charge was neutralized, and how coalescence took place with the formation of a gelatinous precipitate. It is believed that the formation of the flocculated particles may be

[1] Baylis, John R., and Gerstein, H. H. Microörganisms in the Lake Michigan water at Chicago. Municipal News and Water Works, 76:7, 291-6, July, 1929.

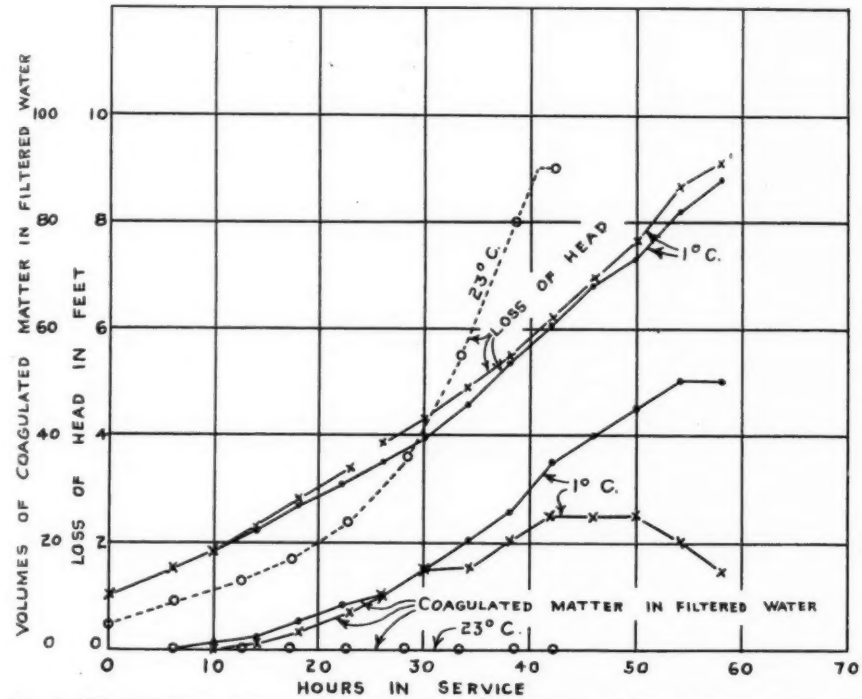


Fig. 1—Effect of Temperature on Loss of Head at Which Coagulated Matter Began to Pass the Filter Beds

explained best by the illustration in Fig. 2. The sketch on the left illustrates coalescence taking place to form chains of the minute solids, which will be designated as fibers or filaments. After the fibers or filaments have formed they begin to become entangled one with another. In fact they probably have a slight attractive force for each other, and probably coalesce where they touch just as firmly as any of the solids that go to make up the filaments have coalesced. If the supersaturation of the solution has not been quite exhausted of the hydrous oxide then the fibers probably build slightly larger in diameter, which no doubt will add considerable strength to them. In water treatment it is believed that the solution is so nearly exhausted of its supersaturation that we can count on but little strength being added to the coagulated matter in this manner. Whatever is the cause of coalescence, it is this force that largely determines the strength of the individual fibers of filaments that go to make up the gelatinous precipitates of aluminum and iron.

After the addition of the coagulant in filtration plants the water is kept in motion to hasten the entanglement of the fibers to form the flocculation. The first flocculation is composed of very small masses, which may be illustrated by the center sketch in Fig. 2. No free-floating or unattached fibers or spherules are shown, though it is evident the flocculation is not so perfect as shown by the sketch. There is a beginning of the union of the small flocculated particles into larger masses before all the fibers have become attached or entangled. By the time the first flocculation has formed it is believed there is almost no supersaturation of the hydrous oxide, and that the number of unattached fibers are so few they are not capable of materially adding to the strength of the larger masses of flocculated matter. Then it would seem that the strength of the coagulated matter which has no reinforcement is determined by what takes place within the first minute after the coagulant is added to the water.

The large particles of flocculated matter so desirable for good sedimentation in water treatment are not built directly from the entanglement of a few fibers which gradually grow in size as more fibers become entangled, but are composed of a number of small flocculated masses which have joined together. If the grouping together of the fibers or filaments first form small flocculated masses as shown by the center sketch in Fig. 2, and it is evident that they do, then the only way the large particle shown by the sketch on the right can form is for the small flocculated masses to unite. The small flocculated masses may be joined together with considerable strength, but they are so small they readily pass through the filter beds when in considerable number in the water. Therefore, the toughness of the large flocculated masses is dependent upon the strength with which the small flocculated masses hold to each other and not upon the strength of the small individual masses as illustrated in the center sketch. This is assuming that there is nothing suspended in the water such as microörganisms and strong gelatinous compounds that may possess strength much greater than that of the coagulant. There is a maximum strength of coagulated matter which is possible to produce, but just how much this strength may be varied by varying the treatment is not known. It is believed that temperature has the greatest influence, the strength increasing as the temperature increases when other factors are the same. This will be discussed more fully in another paragraph.

Perhaps the weakness of the large particles of flocculated matter may be illustrated by comparing with a "brush heap" of small trees. The individual trees, which may be represented by the small flocculated particles shown in the center sketch of Fig. 2, with their many branches hold together with considerable strength, but the "brush heap" itself does not hold together so firmly. It may require less force to pull apart a "brush heap" composed of 100 trees than to pull one tree in two. This may not be a very good comparison for the coalescing force of the fibers that go to make up the gelatinous mass may not be so great as expected. Also the fibers of the flocculated masses where they touch may coalesce just as firmly as any part of the fiber, whereas the limbs of the tree do not adhere where they touch the limbs of other trees. However, it may require nearly as much force to pull in two one of the small flocculated masses made up from an entanglement of individual fibers as is required to pull apart a large mass com-

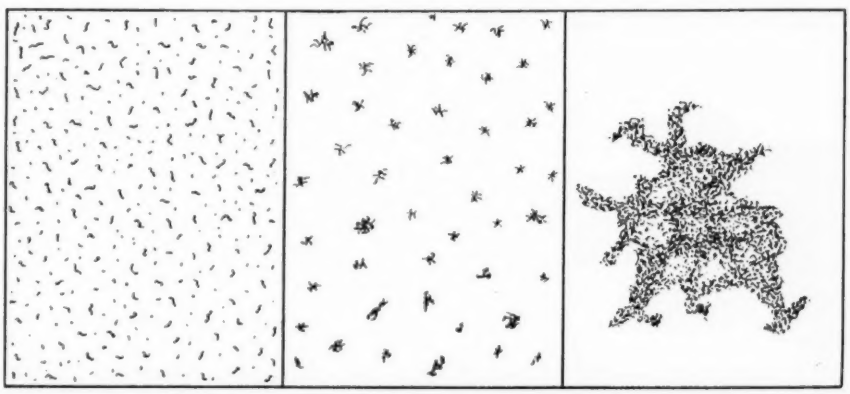

COAGULATION STARTING TO FORM. ABOUT 1 TO 10 SECONDS.
FIRST FLOCCULATION. 1 TO 5 MIN. STIRRING.
LARGE FLOCCULATED PARTICLE. 10 TO 30 MIN. STIRRING.

Fig. 2—Sketches Showing Formation of Flocculated Particles

posed of hundreds of smaller masses. It would be practically impossible to produce enough agitation in the water to break up the flocculated masses to a size less than the first flocculation, but it is not difficult to break the large masses into smaller masses with only moderate agitation.

What makes the small flocculated particles coalesce or join together into larger particles? Is there an attraction of one particle of flocculated matter for another just as there is between the minute solids that build up the fibers? Some colloidal chemists are of the opinion that the coalescence of the minute solid particles that make up the fibers is brought about by two particles colliding in the water and not to an attraction; that is, there is no attractive force so long as the two solids are apart or at least until the solids have come so close together they have penetrated the outer layers of the electrical double layer which surrounds the charged particles. In the discussion of coagulation given in the May issue it was shown that there was an attraction between the chains of solids of calcium carbonate and the unattached solids more strongly at the end of the chains than along the sides, and that the zone of influence was a distance much greater than is generally thought to be the case. This would suggest an attraction of the fibers for each other and probably a very slight attraction of the flocculated particles for each other.

Even though there may be a slight attractive force of the flocculated masses for each other, it is believed that the colliding of the coagulated particles as they float around in the water is decidedly the main way in which the masses are brought together into larger masses. After the masses strike, then what holds them together? Is it merely the coalescing force of the fibers that happen to touch each other, or an entanglement of the fibers on the surface of the mass as the limbs of the small trees become entangled with each other when piled together? If there is a force that holds the minute particles

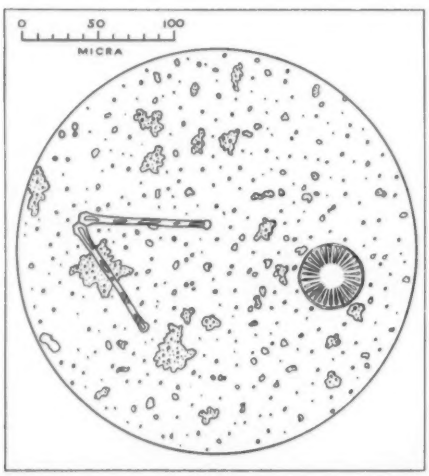


Fig. 3—Suspended Matter in Raw Water for Run No. 2

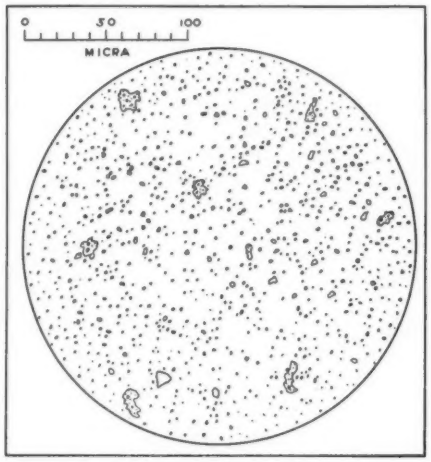


Fig. 4—Suspended Matter in Raw Water for Run No. 3

together when they strike each other, or even an attraction at the ends of the fibers, then it seems that such fibers as actually touch each other when two masses of flocculated matter come together may be held together with at least its coalescing force. The writer is of the opinion that the binding force is due mainly to the fibers on the surface becoming entangled with each other, and only to a slight extent to the coalescing force.

Coagulants are used in such small quantities in water treatment that it may not be possible to vary the strength of the flocculated matter to any material extent by changes that may be brought about in a filtration plant. We have hopes that when we know more about the factors that influence the strength we may be able to increase the strength within certain limits. If the gelatinous precipitate cannot be made stronger in the winter months, which is the time of weakest coagulation, then this should be taken into consideration in the design of the plant by providing longer periods of mixing and settling so as to remove as much of the flocculated matter as possible before it reaches the filter beds. Temperature has an effect, but it is not practical, neither is it desirable to raise the temperature of the water merely to form a tougher coagulation. It seems possible that variations in the coalescing force may be produced, but at the present time we have no idea how this may be done.

Effect of Temperature on the Strength of Coagulated Matter.—Temperature apparently has some effect upon the strength of coagulated matter. This is indicated by the variations in the flocculated matter passing filter beds as shown in Fig. 1. Treating water from the same source at 23° C. and 1° C. with the same amount of coagulant, it is noted that the loss of head for the higher temperature went to 9.0 ft. without any coagulated matter passing the sand bed whereas that treated at 1° began to pass coagulated matter at 2.0 ft. loss of head. This indicates a stronger coagulation for the higher temperature, though the two experiments were not run exactly alike and this may have had considerable influence. The runs for the lower temperature were made by taking water from the settling basin in a filtration plant and running it through a glass tube filter having sand of about 0.5 mm. for the 10 per cent size. The water for the higher temperature was coagulated and settled in the laboratory, and then filtered through a sand bed of the same size sand as was used to filter the cold water.

There was less coagulated matter in the warmer water after settling than in the colder water. Perhaps the difference due to the stirring in the laboratory, and more complete settling, was the major factor instead of the temperature. But there is such a wide difference in the results it is not believed that factors other than temperature could have been mainly responsible. That the amount of coagulated matter going to the filters had some influence, there is not much doubt, yet it is not believed that this could have been the major factor. Plant results with more complete settling than was the case for the runs plotted in Fig. 1 indicate that a higher loss of head could be obtained without coagulated matter passing than with considerable coagulated matter going to the filters, so this very likely was partially responsible. Even though there were several factors that may have lessened the effect of temperature as indicated by Fig. 1, it is believed that temperature was the major factor in producing the differences shown.

Effect of Suspended Matter in the Water on the Strength of the Flocculated Matter.—When microörganisms are not present, it is believed that the character of the suspended matter in water produces the greatest variations in the strength of the flocculated matter. There, of course, is nothing likely to effect the filter runs as do microörganisms, for they may vary the runs from about 2 hours with an abundance of microörganisms of certain kinds to

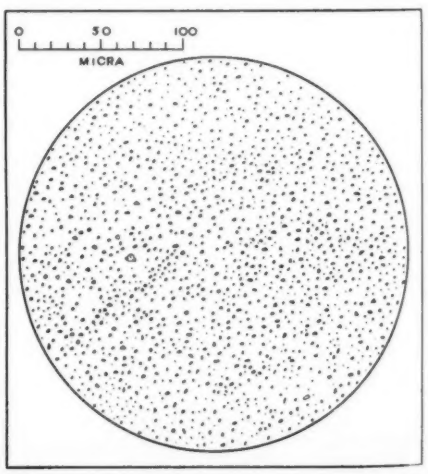


Fig. 5—Suspended Matter in Raw Water for Run No. 5

runs of perhaps 100 hours or more when none are present. Factors other than microörganisms do not vary the filter runs nearly so much, though there still may be considerable difference. If the condition of weakest coagulation is when the water contains no suspended matter and when the temperature is near the freezing point, and this gives filter runs of 100 hours before the loss of head reaches 8 ft., then any shortening of the runs will indicate a stronger flocculation, either from the coagulant itself or its reinforcement with the suspended matter in the water.

With everything else equal we may expect filter runs much shorter at 20° C. than 1° C., sometimes perhaps only one-half as long. With the suspended matter before coagulation of a nature that gives no reinforcement to the coagulated matter, it is likely that no coagulated matter will pass through filter beds at 8 ft. loss of head when the temperature is 20°, whereas at the lower temperature it may start passing before the loss of head reaches 3 ft. Just how much the actual toughness of the coagulated matter is increased due to an increase in temperature there is no way of telling, but it is believed to be anywhere from 25 to 100 per cent stronger at 20° than at 1°. With the temperature near the freezing point and water containing considerable turbidity, but no microörganisms, the runs may vary from 20 to 100 hours, depending on the character of the suspended matter before coagulation. In the warmer months the runs under the same condition of turbidity may vary probably from 10 to 50 hours.

In order to obtain some information as to why the filter runs vary greatly when microörganisms are not present, a study of the turbidity in a certain water was made with the microscope. The drawings in Figs. 3, 4 and 5 show variations in the character of the suspended matter of this water from time to time. Fig. 3 contains microörganisms, but they were of a negligible quantity in the water used for the other drawings. The drawings shown in Figs. 3 and 4 are camera lucida drawings, and Fig. 5 was made from careful observations on the suspended matter with a microscope, but it is not a camera lucida drawing. Table I gives variations in the time required for the loss head to reach 8 ft. when water with and without chemical treatment was run through sand beds of about 0.5 mm. diameter for the 10 per cent size.

It was not expected that the water without chemical treatment would filter clear. The tests were run to get some idea of the amount of suspended matter in the water that was of sufficient size to clog filters. It will be noted that the filter runs in the plant vary in the same direction as those of the filter using water without chemical treatment. In runs No. 1 and No. 2 it is evident that microörganisms were largely responsible for the very short runs. There were practically no microörganisms present for the other runs, yet they varied from 5 to 145 hours for the water that had not been coagulated, and from 22 to 122 hours for the same water in a filtration plant where there was good coagulation and good settling. The gelatinous matter naturally in the water materially strengthened the flocculated matter in some of the runs. Run No. 5 was only slightly more than one-fifth that of run No. 4, and there was very little variation in the temperature. The camera lucida drawing shown in Fig. 3 was the water for run No. 2, the drawing in Fig. 4 for run No. 3, and the drawing in Fig. 5, while not a camera lucida drawing, was characteristic of the water for run No. 4.

Volume of Coagulated Matter in Water Going to Filters Should Be Low When the Water Temperature Is Near the Freezing Point.—There is another factor that has influence on the effectiveness of the filter bed in removing coagulated matter from the water, and that is the rate at which the coagulated matter goes to the bed. Assuming the rate of filtration to be constant and other conditions the same, except the amount of flocculated matter, there is a limit to the amount that may be in the water for all of it to be filtered out when the loss of head has increased to near the maximum. Any increase over a certain amount will cause flocculated matter to pass the beds before the maximum loss of head is reached. If the rate of filtration is lowered, then more flocculated matter may be present and be filtered out, and if the rate is increased the amount of flocculated matter has to be decreased. These are facts fairly well known to filter operators. As a rule, when rates of filtration not greater than 2 gal. per square foot per minute are used, there is not much trouble from flocculated matter passing the filter beds where there is fairly good sedimentation before filtration, except when the water is near the freezing point.

To take care of the times of very weak flocculation which occurs when the water is cold, so that filters with sand of about 0.5 mm. size and 24 in. in depth will run to 8 ft. loss of head without passing flocculated matter, the water in many filtration plants would have to be settled to where the flocculated turbidity is not greater than 2 to 3, and perhaps even less in some plants. It is not possible to settle to this low turbidity in most filtration plants as now constructed. Finer sand and deeper beds will help, but fine sand produces so much trouble in the summer months that it is not practical to use sand finer than about 0.4 mm. In some plants increasing the amount of coagulant will result in less flocculated matter going to the filters, but we cannot rely on this with safety, for when the raw water turbidity is low, increasing the amount may increase the amount of flocculated matter going to the filters. There is no difficulty in getting runs of 24 to 36 hours in the average rapid sand filtration plant without coagulated matter passing if the flocculated turbidity is settled to where only a turbidity of about 5 remains in the water. The loss of head may not go higher than 2 to 3 ft. within this time, but a run of 24 hours does not produce undue operating troubles.

Flocculated Matter Is Compacted in the Filter Beds.—Now we come to the question, why will the loss of head on a filter go higher without flocculated matter passing the bed when the volume of the flocculated matter going to the filter is low? Considerable thought has been given to why this is the case. It is believed to be due to compacting the flocculated matter that has filtered out as the pressure on the filter increases due to the clogging. Going back to the structural formation of gelatinous precipitates as illustrated in the May issue, it was shown that the actual volume occupied by the fibers was only a small percentage of the total volume of the gelatinous mass. It seems reasonable to believe that part of the water of such precipitates may be squeezed out as the loss of head on the filter increases. The squeezing out of the water no doubt is a slow process, and if the volume of the flocculated matter going to the beds is large it cannot be compacted quick enough to keep it from breaking up and being forced on through the beds.

The compacting of the flocculated matter on the surface and within the sand beds is believed to be a very important factor in filtration. Not only does the flocculated matter occupy a less volume, but the compacting causes the mass to adhere more firmly so it is not easily broken up into smaller masses that may be forced on through the filter beds. Examination of the coagulated matter being washed from a filter after it has reached its maxi-

Table I—Comparison of Filter Runs with Varying Character of Turbidity

Run No.	Water Not Coagulated: Turbidity Raw Water	Water Not Coagulated: Turbidity After Filtering	Water Not Coagulated: Length of Filter Runs in Hours	Plant Results Water Coagulated and Settled: Volumes of Flocculated Matter in Filtered Water	Plant Results Water Coagulated and Settled: Length of Filter Runs in Plant
1	9*	2.6	2.5	.0	5.5
2	75*	8.0	1.0	.0	20.2
3	130	20.0	5.0	.0	77.1
4	125	45.0	14.0	30.0	100.0
5	155	27.0	7.3	.0	22.1
6	65	25.0	38.0	30.0	100.0
7	49	20.0	42.4	15.0	64.5
8	22	10.0	145.0	20.0	122.0

*Microörganisms present.

mum loss of head reveals much of the coagulated matter in a very much more compact form than it was in the water going to the filter.

The actual voids in a sand bed probably are about 45 per cent of the volume of the bed. Perhaps 20 to 40 per cent of this void area is capable of being filled with the material filtered from the water. A bed 24 in. deep probably will have an area of about 0.2 to 0.4 cu. ft. per square foot of the bed capable of being filled with the flocculated matter. If the filter runs for a period of 100 hours at a rate of 2 gal. per square foot per minute, 12,000 gal. of water will be filtered for each square foot of filter surface. With a flocculated turbidity of 5, the volume of flocculated matter in the 12,000 gal. of water is somewhere near 0.1 cu. ft. Now it would seem that the void area in the sand capable of being filled is ample, for much of the flocculated matter is compacted quite materially. Usually it is ample, but when the water is near the freezing point there are a few plants that will pass some flocculated matter.

When the flocculated matter is very weak it penetrates into the sand more readily and by the time voids in the upper 12 in. of the sand are partially filled, flocculated matter will begin passing the beds which are only about 24 in. in depth. It cannot be assumed that the 0.2 to 0.4 cu. ft. of void volume per square foot of filter area is all available, or that even one-half of it is available, for there must be a filtration zone which may be only a few inches in depth for the finer sand near the surface of the beds though it very likely is a foot or more for the coarse sand near the bottom of the beds. By the time a large percentage of the flocculated matter is extending 6 to 8 in. below the surface before being filtered out, flocculated matter may start passing through the beds.

If the flocculated turbidity in the water going to the filters is increased, then the time required to fill the voids in the upper part of the bed is decreased, perhaps in a ratio greater than the increase in volume, for the matter filtered out does not have time to become compacted as much as it would be when a smaller volume is going on to the bed. We should expect flocculated matter to pass a filter bed, when twice the volume goes on to the bed, within less than one-half the time for the lesser volume; that is, if with a flocculated turbidity of 5 it is 100 hours before flocculated matter begins to pass the bed it might start passing within 40 hours if the turbidity was 10.

Summary.—The factors that influence the strength of the coagulated matter in water treatment may be summarized as follows:

Microörganisms have the greatest influence in shortening filter runs.

Next to microörganisms, the strength of the flocculated matter is influenced greatest by gelatinous precipitates naturally in the water. Such precipitates probably are largely of organic origin.

Temperature has considerable effect, the strength increasing as the temperature increases. It is neither desirable nor practical to increase the temperature of the water.

The large flocculated particles are built up from small flocculated masses uniting. The binding force of the large masses is not great.

Changes in the chemical treatment may have some influence, but at present we do not know how to modify the treatment to produce a stronger flocculation.

The flocculated turbidity must be very low in the water going to the filter beds when the temperature is low to avoid flocculated matter passing the beds, unless there is something in the water that adds toughness to the flocculated matter.

Consumptive Use of Water by Plant Life

A conference was held under the auspices of the Committee of the Los Angeles Section of the American Society of Civil Engineers on contributions to ground water supplies from rainfall and by spreading of streams, at Los Angeles, March 27, 1928, and at San Bernardino, March 29. Mr. A. L. Sonderegger, Consulting Engineer, was chairman of the committee.

The purpose of the conference was to discuss and determine the research work being done and necessary to permit of a more complete control of consumptive use of water by plants. A reduction in the consumptive use would make a direct benefit to water supply by a decrease in the duty of water, giving water sheds a greater yield. The transpiration and evaporation losses by the forest cover consumes from 40 per cent to 100 per cent of the rainfall. The water supply which is available at the mouths of the canyons is therefore, at best 60 per cent of the rainfall and may be as little as nothing.

The average attendance of the conference was about 100. Addresses and discussions were made by representatives of the Division of Agricultural Engineering, of the U. S. Department of Agriculture, U. S. Forest Service, California State Board of Forestry, Faculty of the University of California, Office of the State Engineer, Consulting Engineers, Foresters and Agriculturists.

The work of the conference was segregated into three activities:

1. Statements of research workers relative to the status of their investigations, their aims and purposes, and the methods applied.

2. Statements by engineers, foresters and agriculturists, as to the need of information for controlling the production and use of water by plant life.

3. Formation of a permanent organization to stimulate research, to assist in securing funds for such research, and to act as a clearing house between research workers and practicing engineers and agriculturists, for data developed.

The conference developed that a great deal of experimental work is being done by the agriculturists and engineers of the U. S. Department of Agriculture, and of the University of California. It was also learned that the California Forestry Experiment Station and the Forestry Division of the University of California are carrying on intensive experimental work in relation to influence of forest cover on run-off, erosion and allied factors.

March 29, 1930, was spent in a field inspection of the work being done by the Division of Agricultural Engineering on the penetration of rainfall north of San Bernardino, and by the California Forestry Experiment Station on the influence of forest cover at their station in Devil Canyon north of San Bernardino. Spreading works at the mouth of Lytle Creek and Santa Ana Canyon were also visited.

The conference adopted resolutions favoring the formation of a permanent organization under the American Society of Civil Engineers and recommended that research work in the use of water by plant life, and consumption of rainfall be specifically included in the water resource studies of the State Department of Public Works, and by various Federal agencies, and that efforts be made to have the necessary funds made available to the various agencies.

Water Works Operations at St. Paul, Minn.—The following note is extracted from the recently issued annual report of the Board of Water Commissioners of St. Paul, Minn.:

"The year 1929 represents in many ways the largest year in the department's history. While the year was not particularly dry, being but 2.79 in. below normal in rainfall, more water was filtered than any previous year, with but one exception. The total revenue for the same year was $981,753.38. The total operating income was $517,231.90; the total gross income $587,808.34; fixed charges paid by the department were $461,868.55, leaving a net income or operating profit for 1929 of $125,939.79. Fixed charges represent nearly 52 per cent of the entire cost of producing water. While this large increase in the net operating profit is due in part to an increase in revenues and a decrease of approximately $15,000 in the fixed charges, there has also been a decrease in the operating expenses of the department."

SEWAGE DISPOSAL WORKS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. DOWNES, Associate Editor

Supervising Engineer, the Plainfield and Dunellen, N. J., Sewage Disposal Works

Sewage Disposal Works of Plainfield, N. J.

While the Plainfield plant has been so frequently referred to during the past ten years in literature on experimental work and while the main part of the plant has been in operation for 15 years I am reminded by frequent inquiries that the plant itself has never been adequately described.

The Plainfield plant, as it is generally called, is really a joint proposition owned and operated by the City of Plainfield and the Boroughs of North Plainfield and Dunellen, under the lengthy, if not enlightening, official title, "The Joint Meeting of the Inhabitants of the City of Plainfield, the Borough of North Plainfield and the Borough of Dunellen." Note the entire absence of any reference to sewage in this voluble corporate name.

This plant was designed on the basis of 40,000 persons contributing 100 gal. per capita or a total of 4,000,000 gal. daily. Metering has cut down the use of water so that the present flow is but 3,500,000 gal. daily although the population exceeds somewhat the 40,000 persons for which the plant was designed. Storm-water is not included and the sewage contains very little trade waste.

The sewage reaches the plant from the collecting systems of the individual municipalities by means of about three miles of 42-in. concrete conduit, which was poured in place, and two pairs of twin 20-in. cast iron inverted siphons to carry the line twice under Green Brook. These siphons are 2,400 ft. and 1,300 ft. long. Considered a part of the joint project, also, is 4,600 ft. of 6-in. cast iron force main to carry Dunellen sewage from its pumping plant to the 42-in. trunk line. The 42-in. trunk line is laid on a grade of 0.5 ft. per 1,000 ft.

Original Design.—As originally designed and built the plant consisted of:

Six Imhoff tanks, 60x25 in plan and 21 ft. deep to the bottom of the hopper, and having two rows of hoppers, five in each row. Centered over each row of hoppers are the gas vents 22 in. wide extending the full length of the tank.

Two 24-in. Miller siphons each entirely independent of the other but receiving the settling tank effluent from a common source, and passing the sewage on to the sprinkling filters.

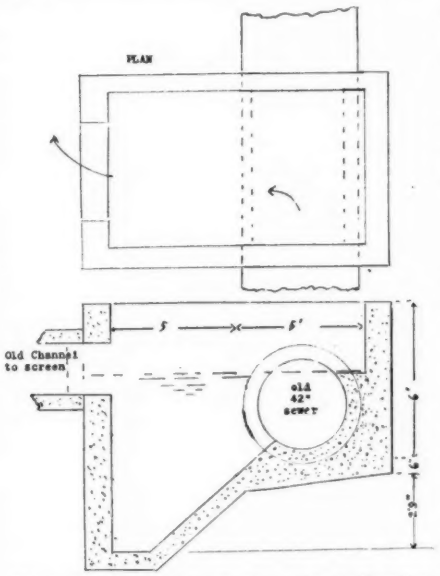


Fig. 1—Plan and Cross Section of Grit Chamber

Two sprinkling filters forced by separate nozzle distributing systems from the two siphons but having no dividing wall; they have a total area of 1.78 acres and are 6 ft. deep.

One final settling tank 97x25 ft. in plan and with a maximum depth of 15 ft. 9 in. below flow line. This tank has Imhoff baffles and traps but a negligible storage space for sludge, it having been the intent to pump the fresh solids back to the preliminary tanks for digestion.

Five sludge drying beds each 84x32 ft. equaling a total of 13,440 sq. ft. Early difficulties with the operation of the Imhoff tanks lead to the installation of a Reinsch-Wurl fine screen of 10-ft. diameter.

While the fine screen assisted considerably in keeping the Imhoff tanks under control, it did not by any means eliminate our troubles in that direction and after various experiments aiming to improve the distribution of solids in the Imhoff tanks and the complete remodeling of one such tank to give a greater proportion of digestion space as compared with the sedimentation space (see Pro. A. S. C. E., Vol. 88, P. 508), the use of two story tanks was abandoned in favor of separate digestion of the sludge under floating, safety covers.

Still later, provision was made for partial aeration of the sedimentation tank effluent for control of odors and later on the use of chlorine was added to this feature.

The following, then, is a complete description of the plant as operated today:

Grit Chamber.—The sewage first enters the grit chamber (Fig. 1), a concrete structure 6 ft. by 9 ft. in plan and 6 ft. deep at the entrance, sloping down to a depth of 9 ft. at the outlet.

This structure is set at right angles to the original 42-in. inlet line between which and a branch channel leading to the screen, it forms a connecting link. The peculiar transverse section is due to the necessity of fitting the chamber between these two channels and to the fact that it was built around the 42-in. inlet line, part of which was afterwards cut away. The steep slope of the bottom provides a hopper for the collection of the deposited material. From this hopper the deposit is raised by air lift to a trough above the flow line where much of the organic matter is removed by washing and the grit is shoveled into wheelbarrows.

Since the purpose of this grit chamber is to remove the maximum proportion of grit from the sewage, and since the accomplishment of this aim is not compatible with simultaneous segregation of grit and organic matter, under the widely varying flows encountered in sewage, it was decided to accomplish the primary purpose by making the chamber of ample proportions to meet the maximum flow and to separate the organic matter by auxiliary washing when the deposit was removed. This washing is done by delivering a constant flow of the deposits, suspended in water, to a trough of uniform cross section. Under these conditions segregation is simple. The deposits are removed and sent through the washing trough daily. An average of 6 cu. ft. of grit is removed each day from 3,500,000 gal. of sewage.

From the grit chamber the sewage flows to the Reinsch-Wurl screen. This screen is 10 ft. in diameter and the slots are $\frac{1}{16}$x2 in. This type of screen

Fig. 2—Floating Cover in Place; Sprinkling Filters in Background

is so familiar that no further description would seem necessary.

As at first installed the screen was equipped with a variable speed motor. The cost of keeping the variable speed control in working order was greater than the saving in current by slowing the screen down during low flows. For a number of years now the screen has been run at a constant speed of 1 rpm.

The original screen plates are still in use after 11 years. The brushes wear from six to nine months.

This screen removes approximately 48 cu. ft. of screenings daily. The screenings contain 88 per cent moisture and weigh 63 lb. per cubic foot.

Plain Settling Tanks.—From the screen the sewage flows to the settling tanks. There are two of these in use, each 25x60 ft. in plan. One has Imhoff baffles which make the effective settling depth problematical—somewhere between 3 and 6 ft.—while from the other all Imhoff baffles have been removed, giving an effective depth of 11 ft. Below this depth, which was the position of the old Imhoff slots, steep hopper bottoms are provided for removal of sludge to the sludge sump.

Both tanks are used as straight settling tanks. The removal of the old baffles not only greatly increases the effective space but reduces the effort necessary to care for the tank. The baffles will be removed from the second tank as soon as possible.

Two 24-in. Miller siphons pass the flow along to the sprinkling filters. The two siphons are entirely independent of each other, each supplying one-half the sprinkling filter area.

Sprinkling Filters.—The sprinkling filters cover an area of 1.78 acres and are 6 ft. in depth. The media is 1½-in. to 2-in. trap rock. The underdrainage is provided by half 6-in. tiles imbedded in the surface of the 6-in. floor on 10½-in. centers. The distribution system is just under the surface with the nozzle base flush with the surface of the stone. Pipe galleries, quarter way in from the sides of the area, carry the distributing main and beneath this the effluent collecting channel. Round Taylor spray nozzles are set on 12-ft. centers.

The sprinkling filter effluent is re-settled in a tank of the Imhoff type. This tank has very little capacity in the compartment below the slots, it having been the intention to pump the solids back to the preliminary Imhoff tanks for digestion.

A 4-in. single Marlow Mud Hog pump, electrically driven, is now hooked up to this final settling tank so that the solids can be sent to any of three sets of drying beds, a special digestion tank near the final tank, back to the preliminary Imhoff tanks, into the plant influent or to the three main digestion tanks.

Sludge Treatment.—From the settling tanks sludge is carried by means of 8-in. cast iron pipe to a sludge sump from which a gasoline driven single 4-in. Mud Hog pumps it to the three digestors.

The digestors are 16 sided tanks 20 ft. deep; two are 38 ft. in diameter and the third is 40 ft. in diameter. They are now practically buried in embankment as protection against cold, but previous to the past winter anywhere from 5 to 12 ft. of the depth has been exposed above ground. Digestion is completed in 40 days at 70° F.

Each tank is provided with a wooden safety floating cover so that the gas can be made available for heating and for power. Fig. 2 shows one of these covers in place and the sprinkling filters in the background, while Fig. 3 shows the covers being constructed. In this photograph the heating coils of the digestion tank supported on small concrete piers are plainly visible. (Note that after the structure had been suitably stiffened, the nest of rafters was cut away from the center so as to leave the base of the 5-ft. gas dome unobstructed.)

Digesting sludge odors are effectively eliminated by this gas collection. Odors at the sprinkler nozzles are cared for either by chlorination or by aerating part of the settled sewage. The aeration plant consists of three Connersville blowers of 370 cu. ft. per minute capacity each, direct connected to three LeRoi gasoline motors rated at 10 to 15 hp. at speeds ranging from 800 to 1,200 rpm.

While these motors are designed to work on gasoline they run very well on the sewer gas collected by the floating covers from the digestion tanks.

The aerating unit is an Imhoff tank in which the old vertical sludge pipes are used as uptake wells in an air lift system. The liquid, sludge and air are drawn up through this uptake pipe and splashed on an apron near the top of the old gas vents, thence tangentially across the surface of the liquid in the former settling compartments, down through the Imhoff slots and back to the bottom of the uptake pipe. Little power is required since the actual lift is from 7 to 9 in.

For further odor control a Paradon

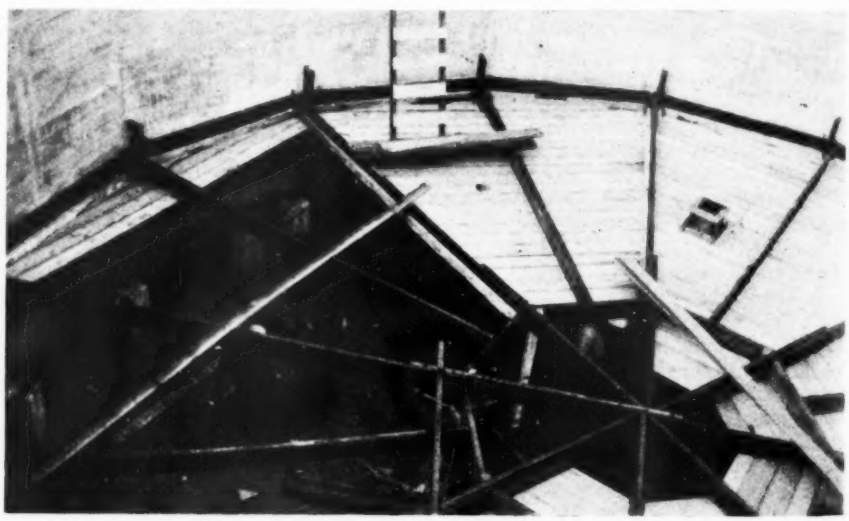


Fig. 3—Floating Cover Under Construction

dry feed chlorinator has been installed to treat the settling tank effluent before it goes to the dosing tanks.

Two convenient methods of dry chlorine application have been used at this plant. When the aerator is working the chlorine can be conveniently applied at the base of the air lift uptake well, taking advantage of the velocity of the liquid rising in this column for mixing purposes. When the aerator is not working the chlorine is applied through a new type of hydraulic diffusor using only 2 gal. of water per minute at a pressure of 45 lb. to secure the required velocity at the point of application. The point of application in this case being in the channel leading from the settling tanks to the dosing tanks.

Sludge Drying Beds.—To the original 13,440 sq. ft. of sludge drying area there has been added 19,600 sq. ft. now used for the digested preliminary sedimentation sludge; and 10,000 sq. ft. used for final tank sludge. This final tank sludge can, however, be put on the area ordinarily used for preliminary sludge as occasion may demand.

The beds are of the open type and are drained by means of open joint tile pipe on 10-ft. centers. Floors are sloped to the drains. Of the several specifications for forming the draining beds the most effective has been to level off over the sloping floors with 1-in. to 2-in. crushed stone, place upon this 5 in. of ¼-in. to 1-in. crushed stone, then 2 in. of ⅛-in. to ¼-in. and finally a very thin layer of sand. Each time the bed is used just enough sand is spread to make the sludge part easily from the fine surface stone.

Sterilization of Water Mains

Use of Portable Chlorinator in Syracuse, N. Y.

By ELON P. STEWART

Division Engineer, Bureau of Water, Syracuse, N. Y.

THE city of Syracuse is extremely fortunate in having one of the purest water supplies in its natural state in the United States.

In spite of this favorable condition, however, the watershed of Skaneateles Lake, which is the source of the supply, is systematically patrolled and pollution kept at a minimum. Moreover, the supply to the city is chlorinated as it leaves the lake as a further safeguard against possible pollution.

The campaign against cross-connections in 1926 and 27, however, brought to the minds of the officials of the Water Supply Division that, while they were using every precaution to safeguard the water supply at its source, there was still considerable danger of pollution after the water had reached the distribution system. Cross-connections were therefore eliminated and attention then turned to the possibilities of pollution due to polluted surface water entering mains where breaks occur at places where the soil is of questionable sanitary nature, and to pollution in new mains where the pipe lays on the ground for some time before it is installed in the ground, subject to street pollution.

This possible source of pollution was brought more favorably to mind in 1928 when a break occurred in a small water main in a section of the city where a fill had been made of ashes and other trash. On turning on the water after repairs were made, it was found that considerable debris had washed back into the broken main while repairs were being made. While no pollution resulted from this experience, it was readily seen that had polluted material been present, the water in that section might have been contaminated.

As portable chlorinators were then available on the market, such an apparatus was purchased and has been used by the Water Division since that time.

When breaks occur now in sections of the city which are subject to ground water of a questionable sanitary quality, or where the fill is of the same nature, a tap is made on the main after repairs have been made and liquid chlorine is introduced into the main as the water is turned on. The boundary valves surrounding the break are kept closed and a hydrant opened, and a suitable flow maintained until the entire section of main within this boundary has been thoroughly chlorinated. The mains are then flushed out with clean water and put back into service.

As a portable chlorinator is especially designed for low rates of application, with a little experience, the operator can easily apply and control a dose of chlorine which will adequately sterilize the main in question.

Tests for residual chlorine are made at the hydrant through which the chlorinated water is expelled from the mains. For this work, a residual of two to four parts per million is maintained after the chlorine has had a 10-minute contact with the water.

The same method of sterilization is used when new mains are put into service, where the pipes have laid for some time on the street prior to installation. In this case, they are apt to be coated with germ laden dust from the streets.

The accompanying illustration shows the portable chlorinator set up inside of the standpipe at Woodland Reservoir preparatory to sterilizing the bottom of this standpipe after cleaning. Several inches of highly chlorinated water were introduced into this standpipe to accomplish this result.

As the chlorinator is compact and easily carried about by two men or by a light truck or car, it is an easy matter to sterilize mains, standpipes or small brooks on the watershed on a few minutes' notice.

It is felt that this piece of equipment has added a real factor of safety to the protection of the water supply of the city of Syracuse.

Photo Courtesy Paradon Mfg. Co., Arlington, N. J.

Portable Chlorinator Set Up Inside Standpipe Preparatory to Sterilizing the Bottom After Cleaning

Nineteen New City Manager Cities in 1929.—Nineteen cities adopted the city manager plan in 1929, the largest one being Flint, Mich., with a population of 180,000. Michigan leads in the number of city manager cities with 44, while Florida has 38, Texas 32, and California 31.

Gyroscopic Precession as the Cause of the Migration of Cyclonic Storms

By HALBERT P. GILLETTE

IN several articles I have shown how free electrons in the air produce cyclonic storms because they are caused to rotate about magnetic lines of force. Once set in motion in this manner the electrons become electromagnets, and they attract to themselves other electrons moving in the same direction, thus building up and intensifying the whirl-belt. But since electrons in opposite sides of such a whirl-belt repel one another, the whirl-belt ultimately expands until it brings about its own destruction, aided, of course, by friction. The free electrons in such whirl-belts attract molecules of air, but their impacts upon air molecules also generate an air whirl.

Small whirl-belts of this sort often originate in the great permanent cyclonic whirl-belts, of which the two best known, are the Aleutian whirl and the Icelandic whirl. These small whirls break away from the great parent whirls and travel in a southeasterly direction. That is the direction in which the southern halves of these two great whirls are rotating, and while their centrifugal force may account for the initial impulse that starts the small whirls on their migration eastward, it is not sufficient to explain their maintenance of a forward velocity of 30 miles an hour, or more, for thousands of miles from their place of origin. At least one cyclonic storm has been known to travel clear around the earth, and perhaps this is a more common occurrence than has been supposed. What, then, is the propelling force?

The books tell us that these cyclonic storms are carried by the general air currents, but laying aside the objection that a general air current in an easterly direction itself calls for a better explanation than the books give, there is the great objection that the forward velocity of a cyclonic storm is often much greater than that of the general air current, if we may judge by the velocity of clouds that are presumably drifting with the air. Often when the air in general is almost still, a local cyclonic storm springs up as if from nothing, and goes scurrying away at express train speed. No, the hypothesis that cyclonic storms are carried along by general air currents is untenable; indeed, even more unsatisfactory than the far-fetched explanation of the rotary motion of cyclonic storms as being due to changes in centrifugal force as the air moves to lower latitudes. How about the rotary motion of the permanent cyclones near Alaska and Iceland? They do not migrate, but they rotate; and we have yet to see any explanation of their rotation that can not be shown to be unsound, except the explanation that they are whirled electromagnetically.

The eastward migration of cyclonic storms from those great permanent cyclones, and indeed, all cyclonic migrations, may be explained by the precession principle of the gyroscopic top, if we substitute electromagnetic force for gravitative force. This principle is stated by Russell (Astronomy, 144) thus: "Any force tending to change the direction of the axis of a whirling body produces a motion exactly at right angles to its own direction." By aid of this gyroscopic principle, the motion of the earth's axis so that it describes a cone, and the consequent "precession of the equinoxes" are explained.

If we regard each cyclonic storm as a magnetic top spinning about an axis, there is no difficulty in understanding why the top travels in an easterly direction around the magnetic pole; for it is obvious that the earth's magnetic pull on this magnetic top can not be equal at all points of its axis, and must therefore tend to tilt it. But the instant that such a tilt tends to occur in a spinning body, it begins to move at right angles to the direction of the tilting force. This gyroscopic principle is commonly illustrated by gravity acting as the tilting force, but a magnetic force can be used instead, and nature evidently furnishes examples of such use in the propulsion of whirling air charged with electrons.

The gyroscopic character of the forward motion of cyclonic storms has been concealed, primarily because their magnetic nature was not perceived, and secondarily because cyclonic tracks or paths often differ greatly from one another. Nevertheless Kullmer discerned that storm tracks across North America and the Atlantic have a tendency to be arcs whose center is the magnetic north pole. But this important discovery was not followed up by any explanation of its cause. It is more nearly true to say that storm centers originating in the Aleutian "low" often tend to follow a track that is approximately perpendicular to the isogonals or lines of equal magnetic declination.

This is only a crude outline of a general tendency, but its existence is evidence of magnetic control of storm tracks.

Until I discovered the existence of magnetic whirl centers near the equator, I was greatly puzzled by the tracks of tropical hurricanes or typhoons. The two regions where this type of cyclonic storm is most prevalent are just north of South America (the West Indian region) and just north of Australia (the Philippine region). These hurricanes usually start in a northwesterly direction, but soon veer to a northeasterly direction, describing tracks that are often almost perfect parabolas. Near each of these regions I have found a magnetic whirl that is clearly disclosed by circular arcs of land, just as the Aleutian whirl is disclosed by the perfect circular arc of the Alaskan Peninsula and the Aleutian Islands. The entire northern and northwestern coast of South America lies on such a circular arc. So do Sumatra, Java and a long string of islands north of Australia. There are 12 such magnetic whirls on the globe. The magnetic north pole lies midway between two of them and the magnetic south pole midway between two others. The equatorial whirls of air that correspond to the molten whirls reverse their direction every six months. This explains the semi-annual reversal of the monsoons of India and of Central America. I will not discuss the cause of these reversals now, merely stating that it is an electromagnetic phenomenon depending upon the relative positions of the magnetic axes of the earth and sun.

The South American magnetic whirl controls the initial direction of gyroscopic precession of the hurricanes of the West Indian region, but when they reach higher latitudes the Aleutian and Icelandic magnetic whirls, and the general magnetic field of the earth, preponderate, and turn the storms northeasterly. A similar phenomenon occurs in the Philippine region; but in that part of the world there are three magnetic whirl centers not far apart in longitude, namely those of (1) Australia, (2) the Philippine Islands and (3) Japan.

Judging by their effects, the 12 magnetic whirl-belts, both in the atmosphere and in the molten interior of the earth, are neither constant in diameter nor in magnetic strength, both of which are affected by the sun's varying magnetic effect on the earth and that of every one of the visible planets, not to mention at least three invisible planets of great magnetic power. Given the resulting variability of magnetic power of these 12 whirl-belts, and of the Heaviside layer, and of the individual cyclonic storms, it follows that great regularity in the tracks of storms should not be looked for.

Since the anticyclones that cause barometric "highs" rotate in a direction opposite to that of the cyclones that cause the "lows," it might be ob-

jected to our magnetic theory of storm propulsion that the anticyclones should move westerly, whereas they move easterly in the higher latitudes. The answer is that every anticyclone is the tail of a cyclone, to which it is bound by electromagnetic attraction. In fact a cyclone and its anticyclonic mate are the two legs of a horseshoe magnet whose curved part is usually miles above the earth. The cyclonic end is the more powerful magnetically, both because it contains more electrons and because it is less expanded. Occasionally the anticyclonic end of such a horseshoe magnet never reaches the earth, for it becomes dissipated. Then we have only a cyclonic whirl near the earth, and are misled into thinking that no accompanying anticyclone exists.

Although the anticyclonic "tail" of a great air whirl must follow the cyclonic "dog," it can wag and it usually does wag. That is why anticyclones often follow cyclones, but not in the same path. Being of opposite polarity to its cylonic mate, an anticyclone is differently affected by the magnetic fields of the earth, and does not behave exactly like its mate. Remember that not only are these two legs of these horseshoe magnets of the air very flexible, but that the arched part of the middle also is flexible, so that the two ends can separate or approach one another. To this flexibility and the frequent difference as to the tracks of these pairs, I attribute the failure of meteorologists to see that cyclones and anticyclones go in pairs that are interconnected, being indeed opposite ends of one rotating mass of air that is bent into a U-shape. That this is the case was suggested to me by the fact that sunspots go in pairs of opposite polarity that cannot be well explained except by assuming them to be the opposite ends of a U-shaped whirl of gas. Then I reasoned that each of the great permanent cyclones on this earth should have a mate in the form of an anticyclone. Turning to a chart, I found the anticyclonic mates of the Aleutian and the Icelandic permanent cyclones, far to the south. I had previously discovered three magnetic whirl centers around the arctic circle, the third one being in Siberia, so I looked for its permanent anticyclonic mate far to the south, and found it on the chart. Since I had found evidence of three similar magnetic whirl centers around the antarctic circle, I looked for three permanent anticyclones far to the north of them, and found all three on the chart in about the expected positions. Several forecasts from a theory that result, as these forecasts did, in confirmation by an appeal to the facts, leave little doubt as to the correctness of the theory.

It matters not to the forecaster whether he must himself experiment to secure the facts, or whether he must wait for nature to produce them, or whether he must search scientific literature to find record of them, for the test of the truth of a theory is its agreement with facts that were not used in framing the theory. A true theory leads to correct inferences, and it is immaterial whether their correctness is determined by ancient history, by present happenings or by events yet to happen. Of course it is more spectacular to "predict forward" and to have the prediction verified years later, as when Halley foretold the date of return of his comet; but it is just as good a test of a theory to use it to "predict backward" and to find that facts already published, but unknown to the prophet, verify his prediction.

Predicting backward, as we like to designate this sort of inference from a theory, has one supreme merit: You need not wait till 17 years after death, as did Halley, to have posterity pat your "shade" on the back and proclaim you a good prophet.

Water-Works Improvements for Cleveland, Ohio

Water-works improvements for the city of Cleveland, Ohio, aggregating a total expenditure of some $60,000,000, are being studied by a board of three engineers, consisting of L. R. Howson, of Alvord, Burdick & Howson, Chicago, Ill.; James H. Herron, Cleveland, and Robert Hoffman, city engineer of Cleveland. The work to be constructed in the immediate future will consist of a 6-mile tunnel into Lake Erie, an additional 100-m.g. filtration plant and 24 to 60-in. mains. The study will also include an analysis of the rate structure which will produce a revenue sufficient to carry the expenditure.

Another very interesting phase of the study concerns a special raw-water supply for industries. The Cleveland steel industries are largely situated on the Cuyahoga River and require large quantities of water, at the present time about 500 m.g. per day being used by these industries alone. The minimum flow of the river is approximately 50 cu. ft. per second, so that during the summer period the water is used over and over as many as fifteen times in its course down the river. The industries on the lower part of the river, of course, get a very hot water, not well suited to the purposes for which it is used. This has given rise to the study of a separate raw-water supply through the construction of a large tunnel to the lake and the construction of shafts on the tunnel at the various industries. Practically all of the major industries have waste blast-furnace gas with which they can do and are now doing their pumping at an exceedingly low cost.

The engineering commission has been at work for some weeks. It hopes to complete this investigation and report some time in May.

Exhibitors at 50th Annual Convention A. W. W. A.

The following is a list of applications for exhibit space at the 50th annual convention of the American Water Works Association, St. Louis, Mo., June 2-6:

Pittsburgh Equitable Meter Co.
Water Works Engineering.
The American City Magazine.
Rensselaer Valve Co.
National Water Main Cleaning Co.
R. D. Wood & Co.
Lock Joint Pipe Co.
Gamon Meter Co.
The Leadite Co.
Bingham & Taylor Corp.
Ross Valve Mfg. Co., Inc.
Neptune Meter Co.
The American Rolling Mill Co.
Paradon Mfg. Co.
Wailes-Dove-Hermiston Corp.
Builders Iron Foundry.
The A. P. Smith Mfg. Co.
H. W. Clark Co.
Buffalo Meter Co.
National Tube Co.
The Central Foundry Co.
Public Works (Journal).
Chicago Bridge & Iron Works.
The American Brass Co.
Wallace & Tiernan Co., Inc.
Michigan Valve & Foundry Co.
Columbian Iron Works.
Waterous Co.
McWane Cast Iron Pipe Co.
Hays Manufacturing Co.
Vogt Bros. Mfg. Co.
Gillette Publishing Co.
United States Pipe & Foundry Co.
Eddy Valve Co.
Hydraulic Development Co.
Iowa Valve Co.
Worthington Pump & Machinery Corp.
East Jersey Pipe Co.
De Laval Steam Turbine Co.
The Pitometer Co.
Pittsburgh-Des Moines Steel Co.
International Filter Co.
Mueller Co., Inc.
Fairbanks, Morse & Co.
Engineering News-Record.
National Meter Co.
Ludlow Valve Mfg. Co.
Ford Meter Box Co.
Badger Meter Mfg. Co.
Hersey Manufacturing Co.
R. W. Sparling.
W. & L. E. Gurley.
American Cast Iron Pipe Co.
The Atlas Mineral Products Co. of Pennsylvania.
The Kennedy Valve Mfg. Co.
Joseph G. Pollard Co., Inc.
Edson Manufacturing Corp.
Johns-Manville Corp.
Lead Lined Iron Pipe Co.
The Dorr Co.
National Cast Iron Pipe Co.
Omega Machine Co.
Automatic Cone Valve Co.
Barber-Greene Co.
Layne & Bowler Co.

Pre-Chlorination of Filters

How Pre-Chlorination at Newburgh, N. Y., Improved Filter Runs and Color Removal and Lowered Wash Water Consumption

By JOHN F. KINGSLEY
Chemist, City Board of Health, Newburgh, N. Y.

THE city of Newburgh, N. Y., is supplied with filtered water from two impounding reservoirs. The filter plant is a modern one of the rapid sand type. The plant was built in 1923 and has a designed capacity of 5.0 m.g.d. The average daily consumption is about 4.0 m.g.d. The water treatment consists of coagulation with aluminum sulphate, aeration of the dosed water, two hours' period of sedimentation, filtration and chlorination. Until lately, the chlorine was applied only to the filtered water as a single dose.

Character of the Raw Water Supply.—The raw water is a fairly soft water of low turbidity and moderate color. The natural alkalinity is sufficient for reaction with the alum, so that this chemical alone is employed to secure "floc." Microscopic organisms have given the chief trouble in treating the supply. With the advent of warm weather in the spring, Asterionella makes its appearance and can become quite troublesome unless controlled with copper sulphate at the reservoirs. The hotter summer months bring profuse growths of Anabaena. Here again the copper sulphate treatment has been resorted to. The spring is also a time of trial due to the heavy infestation of small Crustacea, Cyclops predominating. Copper sulphate treatment has had no effect upon these animal organisms, and we have been compelled to suffer their presence until nature offered relief.

Condition of the Filters.—During periods of active algae growth in the reservoirs the filter beds have been subject to severe surface cracking. Mud balls and wide wall cracks were always attendant and presented a serious and distressing problem which was progressively increasing. At that time we were using the conventional 24-in. vertical rise wash water velocity. As the trouble increased it was observed that the wash water breaking over the troughs did not seem to carry over the usual amount of accumulum and finally came over clean much sooner than usual. Examination of the sand after such washes revealed, as might be expected, that the sand was far from clean. The coating on the grains was as bad as before the wash. Mud balls were very large, some averaging 3 in. in diameter, and were well distributed both horizontally and vertically.

When such a situation presented itself we were forced to treat the filters with caustic soda. We employed the flake chemical and scattered it over the surface of the sand in such amounts that with 1 ft. of water over the sand, the concentration would be about 1 per cent. After the chemical had been dissolved it was thoroughly distributed by stirring with paddles. The caustic solution was then drawn down into the sand by means of the rewash valve, and left in contact with the sand over night. The bed was washed next morning to get rid of the chemical. A second and more prolonged washing was resorted to in order that the loosened sand coating might be scrubbed out. This procedure remedied the trouble but we realized that it was only a relief and that it would have to be repeated regularly unless other steps were taken to prevent the progressive accumulation in the sand.

Experience with Pre-chlorination.—Upon recommendation of Mr. Wellington Donaldson of Fuller & McClintock, Consulting Engineers, New York, N. Y., we started to chlorinate the raw water in August, 1929, and, in addition to the customary effluent chlorination, are still continuing it at this writing. We hoped that the chlorine would control the periodic filter clogging by algae and prevent the formation of the slimy material on the filter walls and sand grains.

To date we are delighted with the results secured. Although it is possibly too early to state that pre-chlorination as practiced at Newburgh will take care of all conditions throughout the year, we are inclined to believe that our particular filter problem has been solved.

The surface and wall cracking has been completely eliminated. When the bed is drained previous to washing, the sand presents a smooth and unbroken surface. It is tight against the filter walls and covered uniformly with a thin layer of coagulum. Under this, which can be demonstrated by scraping away the top layer, the sand is very clean and sharp. Mud ball formation has been very materially lessened and those few that do occur are very small. When a bed is drained down for inspection, after a wash the sand is like clean beach sand. The method of washing remains the same as before pre-chlorination; that is, there has been no increase in velocity or the amount of wash water applied at each wash.

Filter runs have not materially increased over the best runs secured before pre-chlorination. We have, however, to date averaged 20 hours and we have not experienced the former periods of very short runs, which have made it difficult to meet the demand for filtered water.

The effect on the filter walls and troughs has been most gratifying. Concrete work has the appearance of being much cleaner than previously. The slime coating is much lessened and what there is of it is soft, non-adhesive and may easily be washed off with a small garden hose. This advantage has added materially to the good impression made upon our visitors, of which we have a goodly number. The effect of an otherwise clean and sparkling plant is lost when the visitor is introduced to dirty and dingy looking filters.

Another and incidental advantage of pre-chlorination has been the improved color removal. Previously the average color of the filtered water was about 10 p.p.m. to 12 p.p.m. With the same coagulant dose and other factors the same, such as basin retention time and rate of filtration, we now secure a filtrate that averages between 3 and 8 p.p.m., and for the most part below 5.

Bacterial removal has also been increased as might be expected. The average bacterial count in the filtered water on agar at 31.5° C. for a representative period before pre-chlorination was 8.3 per c.c. as against 0.5 for a corresponding period at this time.

Chlorine Doses.—When the experiment was first started we attemped to dose the raw water to such an extent that a residual of 0.10 p.p.m. could be detected in the water as it passed through the filters. Accordingly the raw water dose was set at 6 lb. per m.g. It was soon apparent that such a dose was entirely insufficient to produce the desired results. We then raised the raw water dose step by step until the gas was being fed into the raw water at a rate of 12 lb. per m.g. Even with this rather high dose we were able to detect only a trace of residual chlorine in the filter effluents. For some time while using these higher doses we were in reecipt of growing complaints as to tastes and odors in the water. That the tastes were not ones of chlorine but rather of a "musty" or "woody" flavor, is testified to by our own taste sensations as well as that of many of the consumers. It was then apparent that the tastes and odors were due to chlorine substitution or additional products with the organic material in the raw water, and that some of the methods of de-chlorination would

have to be employed if we were to produce a tasteless water. As our plant is not equipped for such treatment we were forced to lower the raw water dose till the tastes and odors disappeared. We found that a chlorine dose which left just a detectable trace of residual in the water as applied to the filters gave us a finished water which was free from all odors and tastes.

At present we are employing a 3 lb. per m.g. dose. This is of course necessarily governed by the chlorine demand of the raw water and retention time in the basins. Our point of application is not very advantageous, it being after the alum dose and before the water reaches the aerator. This is of course wasteful of chlrine, but for the experiment we decided that it would be more economical to waste a portion of the gas than to go to the expense necessary to provide for a permanent point of application after aeration.

It is estimated that from 25 to 35 per cent of the chlorine gas is wasted in this manner. From this it would seem that under permanent conditions it would be necessary to use only a little more than 2 lb. per m.g. to leave the desired residual on top of the filters. With the chlorine demand of the raw water satisfied or nearly so, it is necessary to apply only from 1.5 to 2 lb. per m.g. to the clear well to maintain a residual of 0.10 p.p.m. ten minutes after application, as desired by the New York State Department of Health. Therefore little if any increase in operating costs is to be expected by the adoption of pre-chlorination at our plant, since a saving of the materials and labor necessary to treat the filters with caustic soda will be effected.

The following table will show at a glance the improvement in filter runs and color removal and the lower wash water consumption:

	August to April, 1928			August to April, 1930		
	Filter runs, Hours	Color Filter, p.p.m.	Per Cent Wash Water	Filter Runs, Hours	Color Filter	Per Cent Wash Water
Maximum	24.5	17	4.3	28.2	9	3.2
Minimum	4.5	5	2.4	16.0	3	1.6
Average	18.3	9.5	3.3	21.3	5	2.6

Conclusions.—Pre-chlorination of the raw water at Newburgh, N. Y., has accomplished several beneficial results, and without any significant increase in cost of operation, as follows:

1. Elimination of excessively short filter runs.
2. Reduction in both number and size of mud balls formed.
3. Elimination of surface cracks and wall cracks in the sand bed.
4. Better color removal with no increase in coagulant dose.

It is interesting to note here that the improvement in condition of filters secured by Hulbert and Herring (Jour. A. W. W. A. 21: 1445) at the Detroit Experimental Plant by using excessively high wash water velocities, has been obtained at the Newburgh plant by pre-chlorination of the raw water.

The Newburgh experiences show that pre-chlorination has the additional advantages of effecting a greater color removal than possible with effluent chlorination alone, and of being able to prevent short filter runs caused by filter plugging by microscopic organisms. Pre-chlorination is certainly less costly than would be the radical changes in design necessary to adopt the very high velocity wash at many plants. Moreover pre-chlorination is not open to the danger of disturbing the gravel layers as Baylis (Jour. A. W. W. A., 21: 1494) in discussing the Hulbert and Herring paper feared might occur by the use of exceptionally high velocity washes.

Annual Meeting Montana Section American Water Works Association

The 5th annual meeting of the Montana Section, American Water Works Association was held in Missoula April 17, 18 and 19. This meeting was characterized by more enthusiasm and interest than evinced at any previous gathering of the section. Those instrumental in securing and fostering this organization were unanimous in the opinion that the section is now on a sure and permanent footing and will go forward.

President Jack Hinman with his engaging personality and enthusiasm was the big drawing feature of the meeting. He made several speeches in which he showed his comprehensive grasp of the problems confronting the water-works operator and administrator. On Wednesday noon preceding the meeting, Mr. Hinman gave a 10-minute talk over the radio at Great Falls (Station KFBB) on the subject of "The Water Supplies of Cities." The range of the station is practically all of Montana and parts of the adjacent territory.

Emil Sandquist, City Engineer of Havre, President of the Montana Section, presided. Mr. Cortese, Superintendent of the City Water Department, Livingston, Vice-President, conducted the round-table discussions and was otherwise active in the business at hand.

The round-table discussions of the first day were a prominent feature of the meeting. The members of the section have much the same problems as confront the men in such work the country over and entered into the discussions with tales of experiences and methods of solving troubles that produced a volume of invaluable information. This was all taken by a stenographer and will be transcribed in detail, as soon as possible.

The papers called for on the program were all given, often illustrated by charts and photographs which increased their interest.

Trips were taken by the delegates to Bonner to see one of the large saw mills in the district in operation, and to the intake works of the local water supply system. At the latter place lunch was served by the Montana Power Co., owners and operators of the water utility in Missoula.

Mr. Christensen, manager of the Missoula branch of the Montana Power Co., was a genial host. He has been a member of the A. W. W. A. since 1919. Mr. Thane, superintendent of the water department of this company, took the brunt of the local arrangements and did his work so thoroughly that never a hitch occurred in the proceedings. All past presidents of the Montana Section were on hand.

The registration list shows 58 names. Other local men visited the meetings from time to time.

The new officers for the ensuing year are:

Mr. J. R. Cortese, Superintendent Water Department, Livingston, President.

Mr. H. M. Johnson, Superintendent Water Department, A. C. M. Co., Anaconda, Vice-President.

Mr. Eugene Carroll, Vice-President and General Manager, Butte Water Co., Butte, Director of the A. W. W. A.

Mr. H. B. Foote, Sanitary Engineer, State Board of Health, Helena, Secretary-Treasurer.

Anaconda was selected as the meeting place in 1931.

Motor Vehicles of Los Angeles Water Department.—The Transportation Section of the Division of Water Distribution and Operations of the Department of Water and Power of Los Angeles, Calif., had 528 automobiles and trucks, 29 trailers and 22 pieces of equipment specially mounted on trucks, at the close of the fiscal year ended June 30, 1929. This shows an increase of 16 automobiles and trucks over the preceding year. This addition to the fleet was made necessary, due to the requirements for additional equipment on the Colorado River project, and the land appraisals in the Owens Valley. This fleet of cars traveled 5,419,192 miles, at an operating cost of 8.75 ct. per mile, as compared with 512 cars traveling 5,313,365 miles for the previous year, at an average cost of 9.01 ct. per mile. This represents a saving in total operating cost of .26 of a cent per mile.

Los Angeles Approves $38,800,000 Water Project.—A bond issue of $38,800,000 for the extension of the Los Angeles aqueduct and the acquisition by the city of water rights in Mono basin was approved at a special municipal election May 20 by a large majority.

Water Works and Sewerage

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The Fruitfulness of a Theory As a Test of Its Truth

In recent years it has become somewhat the fashion to regard scientific theories as mental concepts that have no necessary counterparts in nature. Thus regarded a scientific theory is a "convenient fiction," and therefore a sort of mental chameleon that may change its colors at will. The idea is plausible, but somehow it sticks in our mental gullet, and will not down. Karl Pearson in his "Grammar of Science," has done much to foster this conception. In the same book he extols the theory of mathematical probability, and naturally he does this because the scientific specialty upon which his renown rests is Probability. Let us see what happens when we turn his pet probability guns on his pet metaphysical hobby.

With Stanley Jevons he agrees that the truth of every scientific principle is probable by an appeal to mathematical probability. By that test no scientific theory is better established than that atoms unite to produce molecules. Yet neither a molecule nor an atom has ever been seen under the most powerful of microscopes. Hence it is clear that direct visual perception is not a necessary means of establishing the truth of a theory.

A severe test of the truth of any theory is the occurrence of events in close agreement with predictions based on the theory. This test of validity is not questioned by Pearson, nor, we believe, by any scientist of repute.

A third test of the truth of a scientific theory is its fruitfulness in disclosing unexpected relationships or in facilitating the invention of useful devices. This test is really a special case of the second test, for if a theory can be used successfully to predict future events, it must lead to the prediction of events unexpected not only by men in general but by scientists. We know of no exception to the principle that true theories invariably lead to discoveries of facts or relationships previously unsuspected.

Even were an exception to this principle to be found, it would have to be classed as one so rare as to leave enormous odds in favor of the principle. Hence, it follows that an old theory that fails to be fruitful is probably false.

The theory that theories are purely "convenient fictions" (e. g. the atomic theory) is an old one, and of all the theories that have been proposed to explain mental actions we know of none that has been more barren. What discovery has it ever assisted any man to make? Contrast its utter barrenness with the amazing fecundity of the ether theory, and ask yourself which of the two great English scientists is more likely to be correct, Lord Kelvin, a champion of the ether theory, or Karl Pearson whose theory of thinking led him to deny not only the existence of ether but of molecules, atoms and electrons. Pearson lays down a principle to the effect that where sensual perception of an alleged thing is absent only "convenient fictions" exist. Yet his pet theory of probability sinks this alleged principle at the first shot, and leaves it "without trace," for probability proves the truth of the hypothesis that electrons, atoms and molecules exist and disproves his theory about theories.

We suspect that Pearson's early metaphysical readings had so warped his mental vision that he became a subject of the kingdom of Topsyturviana. There have been many such, who, finding it difficult to understand how a mind can perceive external things, solve their difficulties by asserting that it doesn't. The objective world then becomes forever unknowable in any true sense, and only the operations of the mind remain knowable. Such a metaphysician objects when you affirm a certain characteristic of Mr. Smith, and assures you that all you can safely affirm is that your mental picture of Mr. Smith has that characteristic. You are permitted to believe that the photograph of Mr. Smith is the only thing to be reasoned about, but that the real Mr. Smith who sat for that mental photograph can never be understood!

We could not, and should not, condemn an hypothesis of this sort, nonsensical though it seems, provided—mark well the proviso—that it is a fruitful hypothesis. But when, where and by whom was Pearson's hypothesis or theory ever used to disclose a solitary new fact in the entire realm of science?

"The Mayan Mystery"

Not long ago an article in "Saturday Evening Post" described the ruins of a large Mayan city in Yucatan. The author repeatedly expressed doubt as to the possibility of ever ascertaining why that city was abandoned. In a manner characteristic of too many writers of articles of a popular nature he failed to look up what scientists had said upon the subject.

In "The Climatic Factor as Illustrated in America," published 16 years ago, and again in "Climatic Changes," Prof. Ellsworth Huntington presents a convincing theory of the decadence of Mayan civilization in Yucatan. He points out that climates all over the globe have changed periodically, and he produces a mass of evidence to support the theory that there are great cycles of climatic change, which are counterparts of the minor cycles of weather change. The well known sunspot cycle of 11.2 years is shown to be accompanied by marked changes in rainfall, some regions showing a maximum at the very time that others show a minimum. Cycles of vastly greater length are probably of similar nature. Yucatan is one of the regions whose summer rainfall has increased in recent centuries, whereas in California, Arizona and New Mexico the contrary has occurred.

Excessive rainfall in a tropical region results in

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jungle growth and in a multiplication of insects and bacteria, often to such an extent as to be fatal to men.

Huntington advances a plausible theory to explain such climatic cycles. At least in part it is probably correct. The author of the "Saturday Evening Post" article promises fame and fortune to him who solves this Mayan mystery. Neither fame nor fortune have yet come to Huntington, as a result of his solution of the mystery, not even enough fame to make his work known to an author, who seemingly has pondered over the mystery until it drove him to write at length about it.

Fame rarely, and fortune never, is the reward for solving such a scientific problem. But let a man be first to fly from New York to Paris, and he is apt to be greeted by Fame, dined by Croesus, and decorated by the governments of the world. Contrast such marks of public appreciation for spectacular intrepidity with the rewards of the scientists and the inventors who gave the flyer his wings, and you will better appreciate the immature development of the minds of the vast majority of men. You will understand the feeling that prompted that very original probability specialist, Arne Fisher, to say in one of his prefaces: "In these departments of knowledge the appreciaton of one's peers is after all the only real reward one can possibly expect." But even there the appreciation is very slow in coming, as Fisher's own experience abundantly demonstrates. A man's scientific peers are usually so absorbed in their own problems that they have scant time to appraise the original discoveries of other men, even in their own realm. Moreover, there is an almost universal spirit of skepticism and even of jealousy that operates against an immediate expression of appreciation by even one in a hundred of one's scientific peers. Einstein, with an air of resignation, once remarked that when he first published his epoch-making theory of relativity, just one man in the whole world of science patted him on the back and uttered a word of approval. Small wonder that he now locks himself behind iron doors and seeks rather the approval of his own mathematics. He turns to Old Man Probability and asks his verdict as to each new theory, and when the old fellow calculates an answer that is favorable, Einstein is content to let the scientists of the world think what they may—or think not at all—about it; knowing that the loss is theirs, not his. The greatest reward to a scientific discoverer is the feeling that his work has not been in vain, and the knowledge that no true scientific theory or discovery has ever failed to be useful to mankind.

A New Type of Scientific Text-Book

Several scientific books have recently appeared that consist entirely of important papers or abstracts thereof, in the language of the original discoverers. There is a twofold merit in this type of book: (1) It tends to arouse in the reader to an admiration for research ability; and (2) it aids him in understanding how research is conducted. From this there flows a greater interest in science, for who is there that is not more interested in knowing how a discovery came to be made than in knowing the nature of the final discovery? If a prospector shows you a nugget that he found in Alaska you may be somewhat interested in its size, shape and physical qualities, but you are vastly more interested in the prospector's story of how he found the nugget.

Our scientific text-books are largely museums in which classified specimens are displayed. There you may examine and come to understand the nature of principles that research genius has discovered; but here is nothing, or next to nothing, about the methods used in making each discovery. If you wish to appreciate the vital distinction between the typical text-book and the original story of each discovery, read any text-book on physics and then read Faraday's "Experimental Researches in Electricity." In the one you have some of Faraday's discoveries expressed in condensed form as laws or principles, dull and uninteresting as a rule. In the other you have a picture of Faraday at work, drawn by his own hand. Let authors tell you till the crack of doom that they have collected and condensed for your use all the most worthwhile principles of their branch of science, but don't believe it. Almost invariably they have failed to present you with the most worthwhile part of the whole story of scientific achievement, namely how the discoverer got his first clue and how he followed it up until he made his great discovery.

If it be argued that life is too short and scientific principles are too numerous to be acquired by the long process of reading the full story of each discovery, then our reply is that education is not acquired by learning facts but by learning how to think, and that of all thinking the most valuable is original thinking. We go further, and insist that even ordinary thinking must be, to some extent, original if it is to be very profitable. Utterly unoriginal thinking exists only in the machine-like operations of the brain, such as is disclosed by instinctive actions. Conscious thinking invariably involves some degree of originality, as may be seen by comparing the differences between two bridges of the same span and load-carrying capacity, designed by two different engineers. No two designs are alike in all respects; and to the extent that one of them differs from a mean or typical design, to that extent is it original.

There are occasions when the most economic procedure is to adopt the typical design, but the very act of reasoning that leads to adopting a standard design often shows originality. Nearly every 2x4 architect seeks to be original, and in doing so displays his lack of originality. Standards are anathema to the slightly original mind that is striving to be very original. He delights in differing, whether the difference be one that adds to beauty or utility, or not. So let us not suppose that training in research and in original thinking generally is a training that only a few gifted individuals should be given. The highly gifted ones are the least of all in need of any training save that to be acquired by reading and by self-instruction. For example, schools and classes contributed almost nothing to the success of that marvelous Scotch mathematician, Colin Maclaurin. "His genius for mathematical learning discovered itself so early as at 12 years of age, when, having accidentally met with a copy of Euclid (geometry) in a friend's chamber, in a few days he became master of the first six books without any assistance; and thence, following his natural bent, made such surprising progress, that very soon after we find him engaged in the most curious and difficult problems. Thus much is certain, that in his 16th year, he had already invented many of the propositions afterwards published under the title of Geometria Organica."

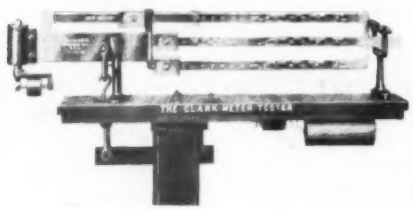
H. P. Gillette

Recent Developments in the Water-Works Field

Improved Devices by H. W. Clark Co.

Devices for the water-works trade brought out by the H. W. Clark Co., Mattoon, Ill., during the last year include a new long-handle key, a scale-beam for water-meter testers, the Klinck test and puddle plug and a line of locked meter-box rings and lids.

Where the long-handle key is used,



Clark Meter-Tester Scale Beam

the meter boxes are placed in a straight line in the parkway as close to the sidewalk as practicable. The meter reader inserts the end of the key in a hole in the lid of the meter box. A twist of the wrist unlocks the box, and the lid is lifted off to the side. The key is provided with a lug on the side which may be used to flip back the lid of the meter. A chisel point is provided on the end of the key for scraping away mud or dirt which may accumulate around the lid. The manufacturers of the Clark meter box have claimed that the box may be unlocked, the meter read and the box locked again in 20 seconds. A series of tests conducted with the long-handle key showed the time consumed to be exactly the same; however, so much less effort was required on the part of the meter reader that the total number of meters read was increased considerably.

The new Clark meter-tester scale beam is designed in accordance with the specifications of the American Water Works Association and the New England Water Works Association. The percentage scale beam is graduated so that the percentage of inaccuracy is based on the amount of water passed through the meter instead of on the registration of the meter. The new scale beam also eliminates all the loose weights which were formerly hung on the end of the scale beam. It is equipped with an electric alarm buzzer, which announces the closing of the test. The sensitivity of the scale has been increased considerably. When the scale is balanced with 100 gal. of water in the tank resting on the scale platform, the addition of ⅛ pt. of water to the tank is sufficient to throw the scale beam out of balance.

The Klinck test and puddle plug, devised by Harry W. Klinck, formerly superintendent of the Logansport, Ind., water works, is used in backfilling trenches after new water mains have been laid.

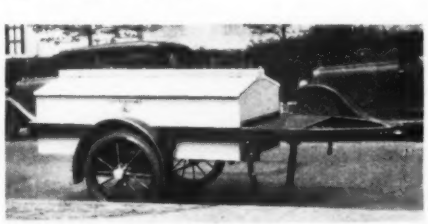
It is customary, when laying water mains, to test the joints under pressure before placing the dirt back in the trench. Then after the joints are found to be tight the trench is filled in. If the soil is not tamped in layers as the trench is filled, a mound several feet high is usually left over the pipe. Tamping, however, is very expensive and slows up the work considerably.

The test and puddle plug serves two purposes. It is inserted in the end of the pipe and tightened in place. This plugs the pipe and allows the water pressure to be applied for testing the joints. Dirt is then dumped into the trench a few feet behind the end of the pipe to form a dam across the trench. A short piece of 2-in. pipe or hose is coupled into the test and puddle plug, water from the main is allowed to fill the trench behind the earthen dam and the soil is dumped into the trench. No tamping is necessary, as the soil packs as it is dumped in trench. While the trench is being filled the test and puddle plug may be removed to allow the laying of additional main. By this method the trench may be backfilled as the work progresses, thus eliminating the danger caused from open ditches.

The new meter-box ring and lid for tile is for use in cities having old meter boxes consisting of a 15, 18 or 20-in. tile with a flat, loose cover of wood, iron or concrete. This type of box can prove a hazard in many ways, but to replace it with a more modern type involves more expense than many municipalities can bear. The locker ring and lid was designed to meet such conditions. The old cover is removed and the ring fitted in place. Thumbscrews on the under side anchor the ring to the tile. The lid is then placed on the ring and locked in place. This repair job is said to involve only one-fourth the expense of a complete replacement.

Two New Tool Boxes Increase Littleford Line to Six

Water-works superintendents should should be very much interested in the two new Littleford tool boxes, No. T-1½ and No. T-½.



New Littleford Heavy-Duty Tool Box No. T-1½

No. T-1½ is a heavy-duty box with 1½-ton capacity. Dimensions of the box are: length, 84 in.; width, 40 in., and depth, 29 in. It is mounted on semi-elliptical springs and has rubber-tired wheels equipped with Timken roller bearings. There are convenient compartments for small and large tools.

No. T-½ is a small splicer box meas-

Littleford Utility Tool Box No. T-½

uring 48 in. long, 30 in. wide and 24 in. deep. It has a waterproof top that opens up. Under the top is a convenient shelf and under the shelf a large drawer. The right side of the box opens down and forms a handy shelf when the box is in use. The strong chassis is mounted on semi-elliptical springs and the rubber-tired wheels are equipped with Timken roller bearings.

The addition of these two new all-steel tool boxes increases the complete Littleford line to six: two heavy-duty boxes, two utility boxes and two stationary storage boxes. Write to Littleford Bros., Cincinnati, O., for complete information.

Mathews Modernized Hydrant Announced

Visitors at the St. Louis convention of the American Water Works Association will have the first opportunity to see the important improvements made by R. D. Wood & Co., of Philadelphia, Pa., in the Mathews hydrant.

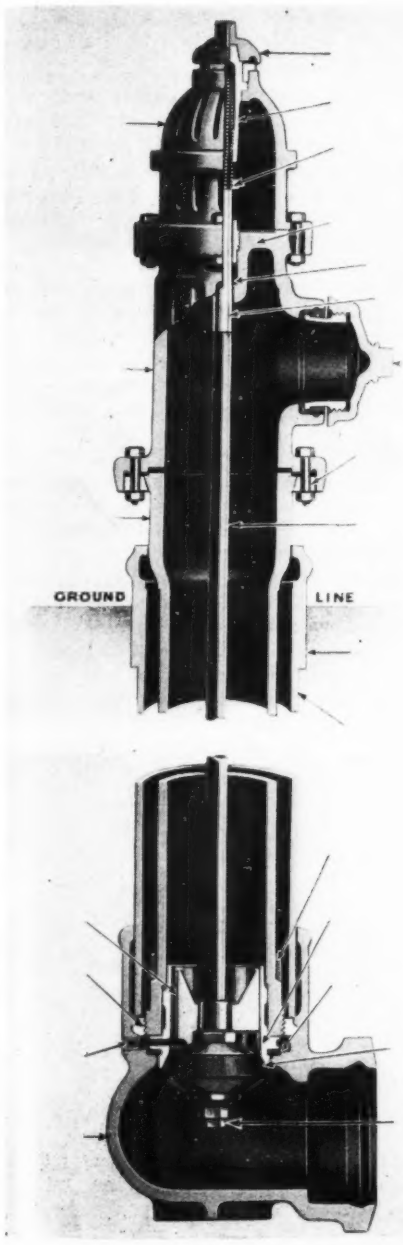
While the basic principles of the hydrant remain unchanged, certain features have been re-designed to meet the modern demand for a hydrant that is stronger, tougher, more resistant to breakage from shock and more easily replaced, if broken by traffic accidents, without digging or breaking the pavement.

The outstanding feature of the Mathews always has been the removability of the barrel, without digging, for repair or replacement. Although more than generally satisfactory in the past, the modernized Mathews improves even this quality. Four sturdy lugs have been cast on the outside of the barrel at the base. A tube wrench slips

down over these lugs, to unscrew the barrel.

At the top of the hydrant a malleable-iron shield-operating nut, resistant to wrench wear, fits down over the bronze operating nut, and is secured by a brass screw in the oil hole. This shield nut prevents rain and sleet from seeping down and freezing around the operating nut.

The wrought-iron operating stem is bronze-bushed at the stuffing box to prevent undue wear on the packing. The stuffing-box plate is cast integral with the nozzle section; thus there is no pressure strain exerted on the head bolts when the hydrant is open, and a separate part is eliminated. As before, there is a bronze stop nut on the stem to prevent the bottom of the stem striking the elbow and buckling, should undue pressure be exerted in opening the hydrant.



Mathews Modernized Hydrant

One of the outstanding new features of the Mathews modernized hydrant is the revolving head, which makes it easy to face the nozzles in any direction, without disturbing the barrel, simply by loosening the bolts in the swivel clamping ring which engages the base flange of the nozzle section.

The overall strength of the new hydrant assures greater resistance to shock. The barrel and protection case sections are cast by the sand-spun method, which produces concentric castings of greater tensile strength, elasticity and toughness.

The cost of replacing broken hydrants has been further reduced by the adoption of a beaded protection case extensions which slips down over the regular protection case. Usually when a hydrant is broken by being struck, it is only the barrel and this extension piece which suffer. The main protection case will rarely be broken, as this beaded extension will receive the major strain of the shock.

The drain valve and the upper section of the main valve are combined in one rugged casting, and the drain valve slides against a bronze cylinder which prevents wear on the liberal size of drain-valve leather. The main valve does not revolve, but moves to and away from its bronze seat with the minimum of friction and wear. Being coneshaped, it opens and closes gradually, thus preventing water hammer and reducing the possibility of gravel or other foreign matter lodging on the seat.

Dependable Remote Indicators for Water Level

Up to this time the extended use of remote indicators and recorders for factors such as water level, temperature, pressure, etc., has been limited because of difficulties encountered in electrical transmission. The old schemes of

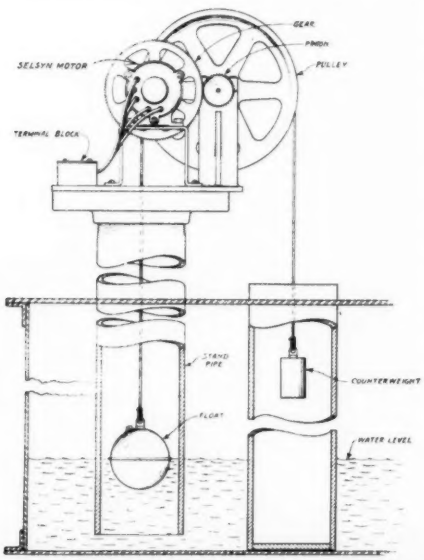


Fig. 1—Transmitting Element Above Maximum Water Level

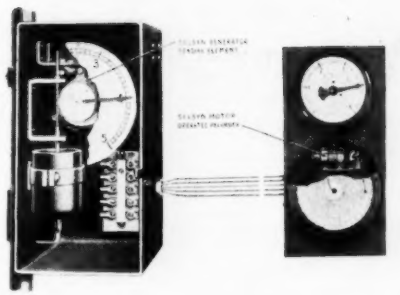


Fig. 2—Selsyn Generator Below Minimum Water Level

transmission were affected by voltage variations and changes in contact resistance, and many of them did not have sufficient power to overcome pen friction on recorders.

These difficulties have been eliminated by the use of Selsyn self-synchronous motor transmission in a new line of Bailey remote indicators and recorders which has recently been placed on the market. The Selsyn motor method of transmission employs a Selsyn generator on the sending end and a Selsyn motor on the receiving end. Three wires are used to connect the stator windings of the generator with those of the motor, while the rotor circuits are connected to a 110-volt supply of alternating current. If power from the same primary source is available at both ends of the system the three wires connecting the stator circuits are all that is necessary for transmission of readings from the generator on the sending element to the motor on the receiving element. The size of wire necessary for connecting the elements depends upon the distance which separates them. A resistance of 35 ohms per connecting wire is allowable.

For transmission of water-level readings the Selsyn generator is turned mechanically by means of a float. On installations where it is desirable to mount the transmitting element above the maximum water level a copper float and chain as illustrated by Fig. 1 are used; and in cases where the Selsyn generator must be located below the minimum water level, a steel float on the open end of a mercury U-tube (Fig. 2) turns the Selsyn generator. When the generator is turned in either direction unequal currents flow in the three lines which connect the stator circuits of the generator and motor. Because of this unequal current flow the Selsyn motor turns through the same angular distance and at the same rate of speed in either direction as does the Selsyn motor. When motion ceases the current flow in the connecting lines becomes equal and is reduced to a negligible amount.

A great variety of receiving instruments is available for indicating and recording the readings transmitted by this system. Round-faced indicators in 27, 17 and 12-in. sizes; one or two-pen

recorders and combination indicating and recording instruments are standard equipment manufactured by the Bailey Meter Co., of Cleveland, O. If desired, several of these receiving instruments can be connected to one transmitting element.

The use of Selsyn transmission is not limited to water level alone but is being used to transmit readings of pressure, temperature, rate of flow, draft and other factors.

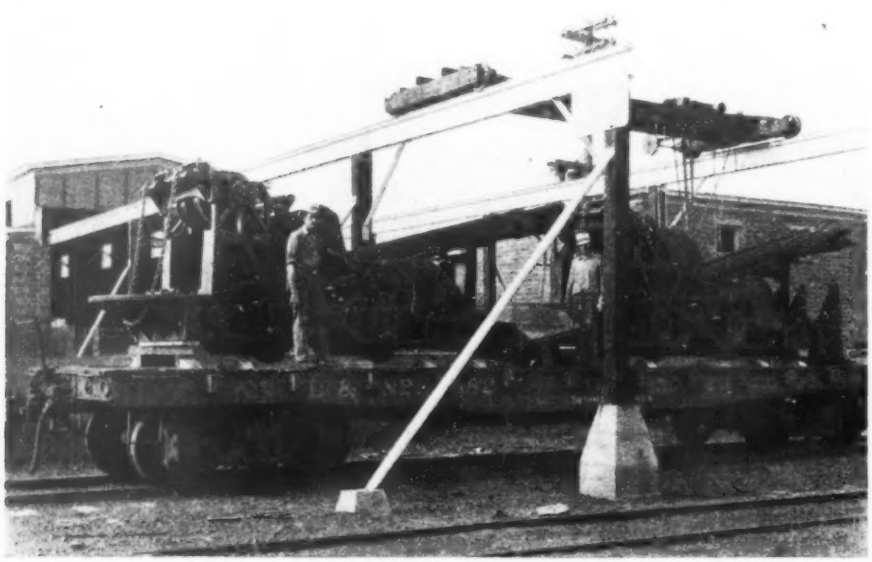
Improvements in Conway Shovels

The accompanying illustration shows two Conway shovels loaded for shipment to the Wachusett tunnel for the water supply of the city of Boston. Six new type 50 Conways were used on this project.

One change in design, noted on the new Conway, is the adoption of an open frame, affording far greater accessibility. The new wheel spread is 54 in.; this additional spread will allow changing the gauge of the machine without having the propeller parts running in between the wheels. The gauge of the new machine can be changed to any other gauge, using the same propeller shaft. On the old type 50 it was necessary to change the propeller unit for every gauge.

The new type 50 has a cast-steel bumper or turntable, whereas the old model had plates. On the mast frame, the I-beam section has been eliminated. The kingbolt is accessible from the outside, whereas on the old shovel it could be reached only from the inside. The new design allows the conveyor I-beam to be bolted right on the bumper and it is not necessary to use the spreader, as on the old type 50. The new Conway has a cast-steel bridge, making the roller unit shorter. The new design also provides for wearing shoes on the boom.

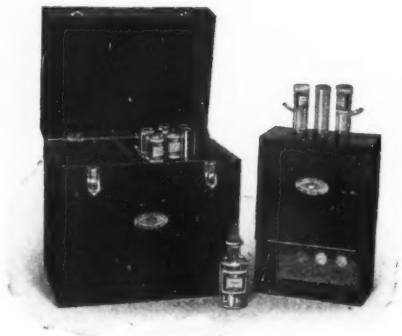
Conway shovels have been used on the Wanaque aqueduct, the Hetch-Hetchy water supply for the city of San Francisco, the Springfield, Mass., Cobble Mountain project and many other water-supply tunnels. Conway shovels are manufactured by the St. Louis Power Shovel Co., St. Louis, Mo.



Two New Conway Shovels Loaded for Shipment to the Wachusett Tunnel of the Boston Water Supply

A New Chlorine Colorimeter

A new piece of equipment, known as the LaMotte chlorine colorimeter, for determining free or residual chlorine in drinking water, has recently been developed by the LaMotte Chemical Products Co., Baltimore, Md. The set consists of eight permanent chlorine color standards in LaMotte sealed Nessler tubes with polished tops and bottoms, representing 0.02, 0.04, 0.06, 0.08, 0.10, 0.15, 0.20 and 0.30 p.p.m. of chlorine respectively; three open Nessler tubes for the test sample; a 50-cc. bottle of ortho-tolidine reagent with 0.5-cc. pipette and nipple, and a LaMott colorimeter for Nessler tube comparison. All this equipment is compactly arranged in a polished wooden case with a sturdy handle for carrying.



La Motte Chlorine Colorimeter

Previously great difficulty has bee experienced with standards kept i open Nessler tubes, due to contamina tion from cork and rubber stopper and both contamination and loss o material if the solutions are kept i bottles and poured into the tubes whe determinations are made. To eliminat these difficulties, all standards, includ ing those for color, nitrogen, chlorin iron, nitrate, etc., are put up in close Nessler tubes with polished tops an bottoms. The standard tubes are fille through side arms which are the sealed off, preserving the standard from contamination of any kind. Th special colorimeter must be used i making determinations with thes sealed standards.

In making the determination, one of the open Nessler tubes is filled to the mark (50 cc.) with the water to be tested, 0.5 cc. of the ortho-tolidine reagent added by means of the pipette, and the tube shaken to insure thorough mixing and placed in the middle hole of the colorimeter.

Two consecutive color standards—for example, those representing 0.04 and 0.06 p.p.m.—are then placed in the remaining two holes on either side of the test sample. The tops of the tubes are held toward a window or other source of daylight, and the standards changed if necessary, until the color of the reflection of the test sample in the mirror either matches that of the reflection of one of the standards or lies between the two. If an exact match is obtained the chlorine concentration in parts per million is read off directly from the standard with which the match is obtained. If the color lies between those of the standards on either side, the reading is taken as the average of the two. Thus if it lies between 0.04 and 0.06, it is taken as 0.05 p.p.m.

This set is also supplied with permanent standards and reagents for determining nitrogen, nitrates, nitrites, total iron, manganese, etc.

The new principle of making determinations by matching the reflection in the mirror, instead of by looking down through the tubes, makes the readings much more simple and accurate.

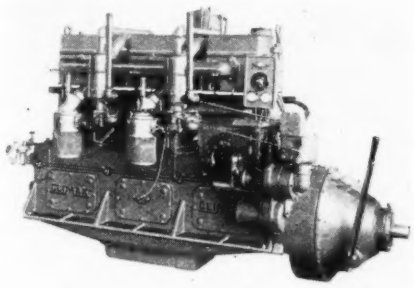
Edson Portable Power Pump Unit

The Edson Mfg. Corp., South Boston, Mass., will exhibit at the St. Louis convention of the American Water Works Association, a recently-developed diaphragm portable power pump—the Edson style OM-T trailer pump unit. This unit embodies the new Edson type M diaphragm pump, which is usable either for open discharge or in connection with a discharge hose as a force pump. This pump will be operated by the Edson air-cooled gasoline engine and mounted on a two-Ford-wheel trailer. This outfit is nicely balanced and is easily managed by one man.

Oil-Burning Engines Announced by Climax

The application of equipment for the burning of distillate on their new Blue Streak engines is announced by the Climax Engineering Co., of Clinton, Ia. These models are produced in five sizes, varying from 70 to 200 hp., and are in the general industrial field.

The outstanding feature of oil burning as applied to these new engines is



New Oil-Burning Climax Engine

the high power and economy being obtained on cheaper fuel, giving about the same performance as gasoline on the average engine of the same displacement. With this increased power, economy in the cost of fuel is marked, the cost running about half that of gasoline. All cylinders on these engines are made of chrome-nickel iron. The bore and stroke are 5½x6½, 5¾x6½, and 6x7 in. in the 4-cyl. models and 6x7 in. in the 6 and 8-cyl. models.

The heads of all of these engines are cast in pairs and are detachable. They are made of chrome-nickel iron with a high Brinell to insure long life.

Crankshafts are drop-forged and heat-treated, and alloy steel is used in the larger sizes. The main bearings are babbitted and bronze-backed and are of ample size and number to insure long life and ability to stand heavy duty. The valves are in the head of the motor and fully enclosed. The intake is of nickel steel and the exhaust is made of silichrome.

Lubrication is highly efficient with a pressure of about 20 lb. to all bearings and overhead-valve rockershaft bearings. The pump is of the eccentric-vane type. A centrifugal pump with shrouded impeller furnishes the efficient water circulation. In conjunction with the special Zenith carburetors used on these engines the intake manifold is jacketed with exhaust heat running warmer than when gasoline is used. A special device also is added, consisting of a heat control of the primary air and water injection. The heat control mechanism consists of a sylphon similar to that used in the spark control mechanism. This is actuated by the change of pressure in the intake manifold, which is transmitted to the sylphon by copper tubing.

A flat valve at one end of the sylphon controls the amount of heated air admitted to the carburetor. As the throttle is opened, the manifold pressure approaches atmospheric and the sylphon expands. The flat valve moves to cut off the hot air from the exhaust jacket and starts to take unheated air until none is admitted when the throttle is wide open.

In order to permit higher power output and higher compression heads, water is injected into the intake manifold for throttle positions greater than three-quarter openings. This is controlled automatically. This water is pumped by an A-C fuel pump, handling water instead of fuel at pressures of from 3 to 4 lb.

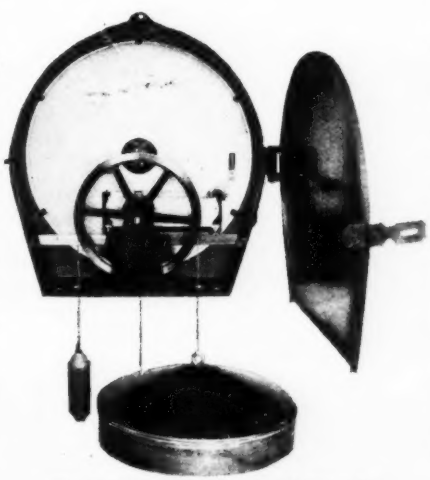
New Water-Level Recorder

A small, compact water-level recorder using a circular disk chart has recently been put on the market. It is designated as the Stevens type N water-level recorder, another of the complete line of water-level recording and indicating instruments of Stevens design.

This instrument is completely enclosed in an aluminum case with hinged door. A counterpoised float resting on the water surface moves the pen or pencil laterally a total distance of 4 in. for English units or 10 cm. for metric. The total range of water level is thus reduced to convenient scales of record. The instrument will accommodate a total range of 4 ft. or 1 m. of water-level fluctuations. Height scales may be 5:12, 1:6 or 1:12 in English units or 1:2, 1:5 or 1:10 in metric units.

Instruments may be equipped with 12-hour, daily or weekly charts and for either ink or pencil records. For pencil records a coated paper is used so that the slightest pressure of the pencil makes a distinct line.

Complete information may be had from the manufacturers, Leupold, Volpel & Co., Portland, Ore.

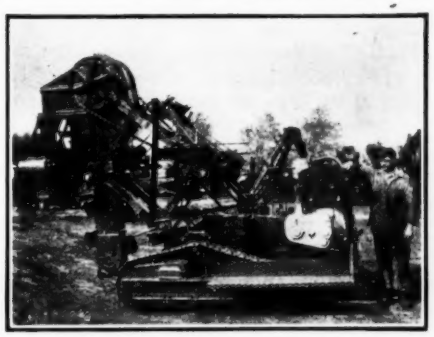


Stevens Type N Water-Level Recorder

New Offset Vertical-Boom Barber-Greene Ditcher

A new product of the Barber-Greene Co., Aurora, Ill., is a light ditcher with an offset vertical boom. The offset boom is not offset in any fixed position but may be set at any desired position between the crawlers on which the machine is mounted, and locked there.

This new product is patterned gener-



Barber-Greene Light Ditcher

ally after the well-known standard vertical-boom ditcher, and there are several noteworthy features incorporated in its design.

The vertical boom—a patented Barber-Greene feature—has become familiar to ditching contractors on the larger B-G model 44-C ditcher.

Another feature of the new utility ditcher is the automatic overload safety sprocket. This affords protection for the machine against overloads, and for pipes and other underground installations against breakage which would prove expensive to the contractor. When an obstruction is encountered, the sprocket slips, stopping the bucket line, catches every half revolution, then slips again. This action will continue without harm to the machine until the obstruction has been removed, or the buckets have milled through it.

The boom is raised and lowered by power, and an automatic throw-out makes it impossible to raise the boom too high.

Whe whole machine is mounted on sturdy crawlers of standard Barber-Greene design by means of a fixed and an oscillating axle. The oscillating axle provides three-point suspension for the machine, which enables it to ride over rough ground and stay on an even keel.

The machine is powered with a Buda 38-hp. gasoline engine and is driven through two especially designed transmissions. It has four road speeds—three forward and one reverse, with a high forward speed of 2½ m.p.h.—and a great number of digging speeds, ranging from 12 to 148 in. per minute. There are cutting speeds to suit any soil condition.

The utility ditcher cuts a trench from 9 to 18 in. wide and from 4 to 5 ft. 6 in. deep. It is light, compact and sturdy.

Pipe-Handling and Backfilling Unit

The W-K-M boom and side winch is now being manufactured for mounting on the model DH Trackson McCormick-Deering tractor. This equipment, which is made by the W-K-M Co., Inc., Houston, Tex., greatly increases the versatility and usefulness of the Trackson unit. With the W-K-M boom it is adaptable to backfilling, by the use of a throw-back bucket or Mormon board, pipe handling and laying and other similar operations.

This combination of equipment is stated to lift and carry loads of 4,500 lb. and will raise much heavier loads when a stiffleg is used.

The boom may be mounted on the tractor quickly and easily in the field, since the installation requires no drilling or cutting. An outstanding advantage is the fact that the boom when installed does not interfere with the use of the tractor for drawbar operations.

The W-K-M equipment is made of best quality steel castings throughout. The normal length of the boom is 13½ ft.; extended, its maximum length is 19 ft. The side winch has two drums, each with a capacity of 495 ft. of ½-in. cable. The clutches are of the internal expanding, two-shoe friction type, 13¾ in. in diameter and each 35 in. long. All shocks and strains to the boom and side winch are absorbed by A-frames provided at each side of the tractor, and the equipment is provided with ball-and-socket joints thoughout to overcome strain through track oscillation.

Mormon boards, special sheaves, stifflegs, pipe hooks for various sizes of pipe and other extra equipment for this unit may also be obtained. Either the Trackson Co., Milwaukee, Wis., or the W-K-M Co., Inc., Houston, Tex., will furnished complete information on request.

W-K-M Boom and Side Winch Mounted on Model DH Trackson McCormick-Deering

FWD Auto Eductor

One of a pair of FWD sewer cleaners recently put into service by the city of Milwaukee, Wis., is shown in the accompanying photograph.

FWD Auto Eductor in Service in Milwaukee, Wis.

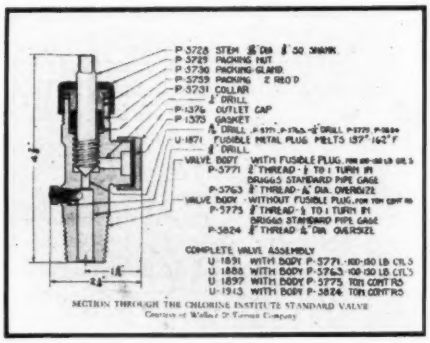
The unit consists of a watertight body holding 1,200 gal. or 6.2 cu. yd., mounted on a six-wheel truck with four-wheel drive on the front and first rear axles. The truck is equipped with ten tires to carry the enormous weight of the machine. When the sewer cleaner is to be operated, the large tank on the truck is filled two-thirds full of water. A pump operated by a separate motor is connected with this body. On reaching a catch-basin, two telescopic pipes are lowered into the filth. The pump draws water from the body and forces it down into the catch-basin in one of the two pipes. At the end of this pipe is an elbow which is fitted on the end with a nozzle which reduces the downcoming 3-in. stream down to 1⅛ in. in size. The reduction in size of the stream increases its speed and velocity and also creates a suction. Around the nozzle which points upward in the second telescopic pipe is a collar or opening which permits refuse to be sucked in. The suction created by the swiftly moving stream draws in the catch-basin refuse and it is immediately hit by the stream of water and forced upward in the pipe to the body or large tank on the truck.

This dirty fluid is carried to the rear of the body and released there. The dirt in the water settles to the bottom of the tank and the water works its way through baffle plates toward the front end of the body. Pumping is kept up from one catch-basin to the next until all the water in the tank has been displaced by muck and the tank is full of refuse. The unit is then driven to a dump and unloaded. Because of the bad roads ordinarily found in the dumping grounds and the unusually heavy load to be carried, the four-wheel-drive feature is very desirable.

This unit is manufactured by the Four Wheel Drive Auto Co., Clintonville, Wis.

The Chlorine Institute Valve

A development of the past year worthy of mention is the increased use of the new Chlorine Institute standard

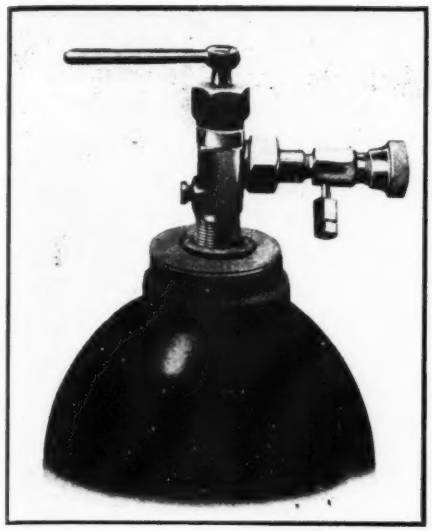


Section Through Chlorine Institute Standard Valve

tank valve for chlorine cylinders and drums, produced through cooperation between equipment manufacturers and health and water-works officials.

Although water-works officials had for years, on frequent occasions, experienced delays and inconveniences due to receipt of a shipment of chlorine-gas cylinders requiring yoke connections for auxiliary valves when fittings on hand were for the union type of attachment, and vice versa, it required an emergency situation developed in the course of relief work following the Florida hurricane of 1926 to bring the seriousness of the then existing practice to a head.

The incident in point occurred at Hollywood, Fla., in September, 1926,

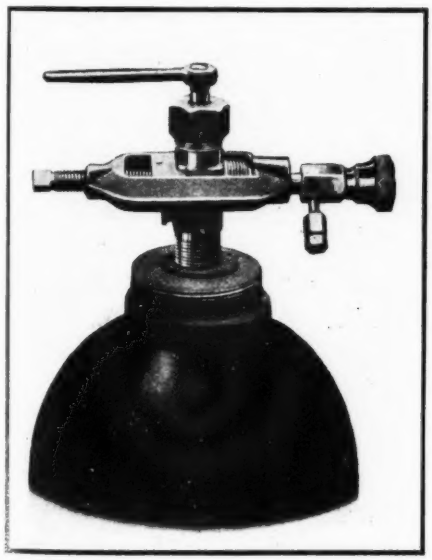


Chlorine Institute Standard Valve with W&T Union-Type Auxiliary Valve

when a shipment of several cylinders of chlorine gas delivered for emergency chlorination of water supplies could not be used because the cylinders required yoke-type fittings while only the union-type connections were on hand.

At a special meeting of the Public Health Engineering section of the American Public Health Association on Oct. 13, 1926, at Buffalo, N. Y., experiences in emergency chlorination of public water supplies following the Florida hurricane were the subject of a very interesting discussion. Before the close of the meeting the following motion was made, duly seconded and carried unanimously: "Moved that the secretary communicate with the Chlorine Institute and also the American Water Works Association with reference to the standardization of tank valves on chlorine cylinders."

On receipt of a communication from



Chlorine Institute Standard Valve with W&T Yoke-Type Auxiliary Valve and Yoke

Arthur E. Gorman, secretary of the Public Health Engineering section, referring to this action of the section and requesting its serious consideration by the Chlorine Institute, the directors of this organization at a meeting on Dec. 16, 1926, forwarded the communication to a special technical committee for investigation. This committee, after a very careful survey of conditions and a study of all types of valves, designed an entirely new valve, adaptable to both union and yoke-type connections, which was accepted and is now being manufactured. It is known as the Chlorine Institute valve.

Investigations of this committee showed that but a relatively small percentage of the chlorine valves owned by manufacturers in the chlorine industry were used in the sanitary field; also that the investment in these valves was a substantial one, making their discard for new valves an expensive matter. However, in view of the health aspects of the situation, the manufacturers decided on a policy of purchasing Chlorine Institute tank valves for the replacement of all discarded valves in use. The replacement by new valves was then confined entirely to containers used in the sanitary field.

It was estimated that this procedure would over a period of a few years permit the replacement of all valves used in the sanitary departments of their business with the new Chlorine Institute tank valve. It is estimated that to date there are approximately 25,000 of the new valves in use.

They are being manufactured exclusively by the Wallace & Tiernan Co. and users report very satisfactory results with them. The new valve incorporates the best features of all valves in service. Among the features of the valve are a one-piece genuine monel metal stem; a brass forged body with 3/16-in. seat opening for the cylinder valve and ¼-in. seat opening for the ton-drum valve; an extra long and over-size shank thread which allows for wear of the thread in the cylinders and gives increased length of life of the body; brass packing nut, gland and ring, so arranged as to permit packing the valve while in service; the use of soft packing, and the use of a removable bronze fusible-metal container plug. The fusible metal repsents the result of extensive research work carried on by the members of the Chlorine Institute. The outlet connection has the ¾-in. external straight pipe thread which has been used in the industry for years to accommodate a union connection and is also equipped with a recessed gasket surface to accommodate the use of an adapter and yoke. The packing nut takes the same wrench as the outlet cap.

Another New Oxweld Welding Blowpipe

The Oxweld Acetylene Co., New York, N. Y., has recently announced another new blowpipe. The type W-17, as it is called, employs the same well known low-pressure injector principles used in other Oxweld blowpipes. It is somewhat similar in design to the type W-15 aircraft-welding blowpipe which has met with such great favor since its introduction about a year ago. The type W-17, however, is a full-sized blowpipe, large enough for any welding job and so carefully designed and constructed that it may be used for the finest of welding craftsmanship.

New principles of design have been incorporated in this blowpipe. The tip and welding head are of one-piece construction, being combined in a long and slender stem of the gooseneck type. Careful study has been devoted to the design of the injector and mixing chamber for each of the ten welding heads. The injector is at the base or handle end of the stem. Each welding head has its own nut for attaching it to the handle of the blowpipe. The

Oxweld Type W-17 Blowpipe

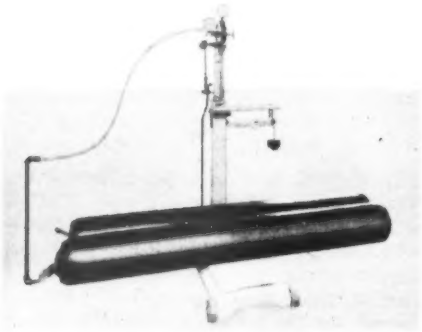
nut has been constructed so that it extends beyond the injector when the welding head is detached from the blowpipe and serves to protect the injector from damage due to careless handling. A fine-pitch thread makes it possible to tighten or loosen the nut easily without the use of a wrench. The handle of this new blowpipe is made of a special brass tubing having longitudinal ribs. This offers a sure grip to the operator and also reinforces the handle. The valve wheels are of a new design and are placed so as to be readily accessible, yet out of the way during the welding operations.

The type W-17 blowpipe is compact and light. With the No. 4 welding head it weighs but 24 oz. The long, thin shape of the welding heads make it possible for this blowpipe to be used in places inaccessible to almost any other type of equipment.

The inner cone of the flame of the type W-17 blowpipe is somewhat different from that obtained with any other blowpipe. It is shorter and thicker and has a tendency to assume the shape of a ball at the end. This speeds up the rate of welding because a large portion of the high-temperature flame (or inner cone) surface is brought closer to the metal.

A New Ammonia-Feeding Apparatus

The Paradon Mfg. Co., Arlington, N. J., has developed an apparatus for the application of anhydrous ammonia known as the Paradon ammoniator. The ammoniator consists essentially of a Paradon dry-feed chlorinator constructed of materials that will withstand and handle ammonia.



Paradon Ammoniator

The anhydrous ammonia enters the apparatus as a gas under full tank pressure. The ammonia pressure gauge indicates the tank pressure of the ammonia upon entering the apparatus. The pressure of the ammonia is materially reduced by an inlet valve actuated by a diaphragm. The ammonia passes along the diaphragm and through the orifice. The flow of the ammonia is regulated by varying the drop in pressure through this orifice. A manometer indicates the flow of ammonia through the orifice. The flow through the orifice is regulated by regulating the difference in pressure between the front and rear of the diaphragm. After passing through the orifice, the ammonia flows through a meter pressure and shut-off valve. The function of this valve is to maintain the ammonia at a back pressure equal to the back pressure under which the orifice is calibrated. The shut-off valve enables the apparatus to be shut down when not in use and kept filled with ammonia under pressure, thus preventing the entrance of moisture or dirt. From the meter pressure-shut-off valve, the ammonia goes directly to the point of application.

If desirable, the ammoniator can be provided with an injector, and the ammonia gas first mixed with an auxiliary water supply in the injector and the resultant ammonia solution applied at the desired point of application.

The ammoniator can be mounted on either a metal pedestal or it can be combined with a platform scale. The ammoniator is ordinarily finished in light green Duco enamel.

The ammoniator enables the ammonia to be applied accurately and thus makes it possible to maintain constant the ratio between chlorine and ammonia found most suitable for the plant. The ammoniator also prevents any possibility of freezing due to too rapid expansion of the ammonia. It, of course, prevents the leakage of ammonia, which is an objectionable gas unless properly controlled.

The ammoniator can be used not only for the application of anhydrous ammonia in the water purification, swimming and sewage fields, but also for controlling anhydrous ammonia for practically any purpose.

Two New Unit Trenchoes Announced

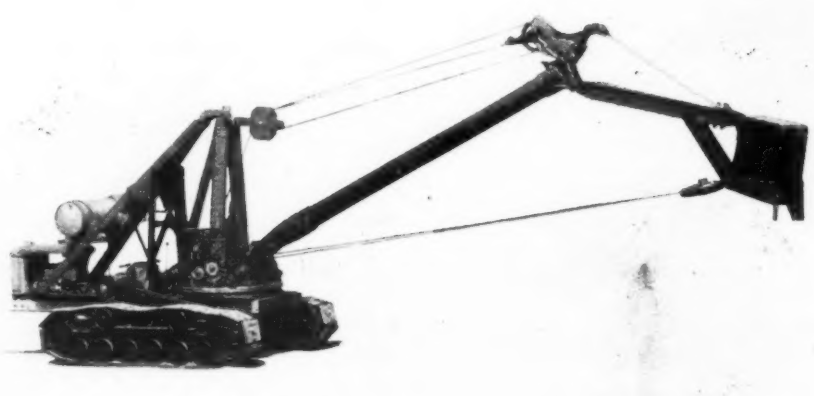
New products of importance to the water-works and sewerage field are the new Unit trenchoes, models 310 and 512. These models are innovations in that the structural member of the boom is circular in cross-section. These trenchoes are manufactured by the Universal Power Shovel Co., Milwaukee, Wis., a division of the Unit Corporation of America.

The cylindrical boom has proved its great strength after long, severe tests. Recently a machine, after completing a water-main trench in Detroit, moved into a basement to assist in digging the foundation. The excavation yardage compared very favorably with shovel operation because of the speed of the dipper, which can easily move through four dips per minute.

Another important feature in this small, fast trenchoe is the new disc-type clutch. The clutch is so constructed that it can be adjusted at a single point without the assistance of a wrench and the adjustment is a matter of seconds only. The clutch facings are guaranteed for a year. This unit clutch makes operation easy—so light, in fact, that it is stated the operations can be controlled by the pull of a finger.

The gears are all of drop-forged, double-heat-treated alloy steel. Bores are ground true to center after heat treatment.

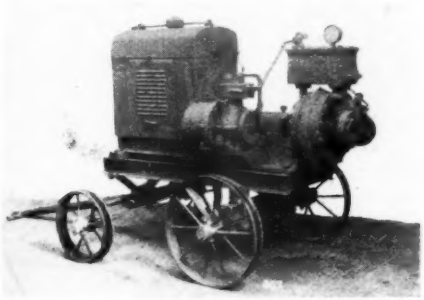
Unit excavators are presented as machines which can render important service in moving material at low yardage cost. The trenchoe is easily and quickly converted to shovel, clamshell, dragline, crane and backfiller; and these changeovers may be made readily in the field.



Unit Model 310 Three-Quarter-Revolving Trenchoe

Automatic-Priming Pump by Domestic

A recent development of the Domestic Engine & Pump Co., Shippensburg, Pa., is their No. 3, type 52, 3-in. automatic-priming centrifugal pump. These units are automatic priming and will



Domestic 3-In. Automatic-Priming, Trash-Handling Pump

prime themselves from vertical lifts up to and including 27 ft. The priming device consists of a highly-efficient vertical, piston-type vacuum pump, a vacuum-control regulator and an air-tight check valve in the discharge line of the centrifugal pump.

These units are designed to handle not only clear water, but also solids approximately one-half the diameter of the intake opening of the pump. They will handle such debris as sticks, stones, muck, etc., and have worked out very satisfactorily with contractors and sewer departments in different cities.

The 4-cylinder engine has a speed range of from 900 to 1,400 r.p.m. and develops 10¼ hp. at 1,400 r.p.m. Standard mounting consists of a two-wheel trailer with rubber cushion tires. Plain steel-tired wheels can be furnished if desired. A four-wheel truck, as shown in the illustration, is furnished on special order. Capacities for various heads may be secured upon application to the manufacturer.

Paige & Jones Apparatus

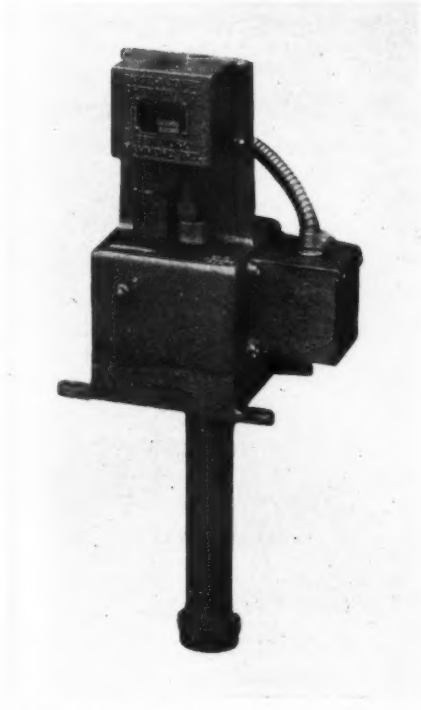
Two new devices, a hydro-acid pump and an electromagnetic proportioner, have been brought out during the past year by the Paige & Jones Chemical Co., Hammond, Ind.

The hydro-acid pump is the result of demands for an adjustable-stroke, low-capacity, cheaply-maintained pump to handle ferric alumina, ferric chloride, aluminum sulphate and any other acids in concentrations not injurious to rubber.

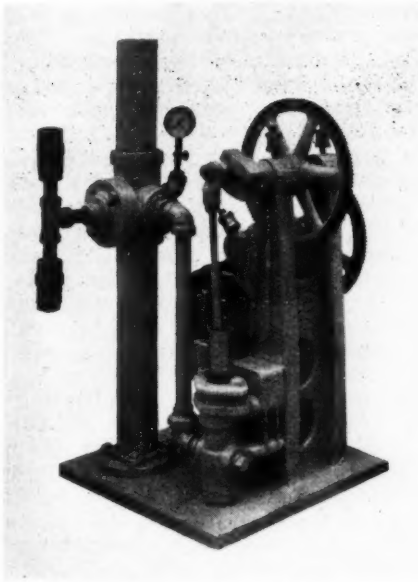
Referring to the illustration, the acid part of the pump consists of the hard-rubber check valves and fittings shown at the extreme left which pass through the side of the cast-iron and steel cylinder connecting with a gum rubber sack which hangs within this cylinder. There is nothing more than this to the acid portion of the pump and it is quickly and easily removed for inspection or repairs if needed.

The pumping impulse is supplied by water or other suitable hydraulic fluid on the outer side of the rubber sack in the steel cylinder, pressure and vacuum alternately being applied to the solution, thus causing the rubber sack to fill and empty itself at pressures up to 125 lb. per sq. in. The alternating impulses to the hydraulic fluid are supplied by an ordinary piston pump with an adjustable stroke geared to a General Electric motor.

The upper part of the casing at the left contains mechanism for preventing the collection of air in the hydro side of the system due to leakage at the piston.



Paige & Jones Electromagnetic Proportioner



Paige & Jones Hydro-Acid Pump

The pump is built in standard sizes of 60 g.p.h., 150 g.p.h. and 300 g.p.h., and larger on special orders. The pump is guaranteed self-priming and dripless, there being no stuffing-box in connection with the acid part of the pump.

The electromagnetic proportioner shown in the accompanying photograph is an improvement over the model brought out by Paige & Jones last year in that it contains a magnetic clutch and dashpot.

This device makes possible more accurate proportioning of chemicals to water. It is used in proportioning lime, soda-ash or any other chemical. It operates off a meter with electric contacts and, since the stroke of the solenoid can be lengthed or shortened at will, immediate readjustment of chemicals is possible.

A large number of these devices have recently been installed at water treating plants on railroads, industrial plants and municipal plants where greater accuracy of proportion and instantaneous readjustment are desired features. The device is essentially a robot and performs its duty as all good robots should.

Armco Drainage Developments

Increased use of Armco corrugated-iron pipe, installed by the Armco jacking method as conduits for water mains, gas lines and sanitary sewers is reported by the Armco Culvert Manufacturers' Association, Middletown, O., by whom this method was developed.

Numerous openings created under busy streets, railroad lines and high embankments have shown this means of conduit installation to be possessed of the following advantages: no interruption to traffic, no marred pavement to replace or settling fill to maintain and usually a much lower cost of installation than that by the tunneling or open-trench method. Where traffic is heavy and covering shallow, laying the main in the sturdy corrugated-iron pipe protects it from vibration. If for any cause a break should occur in a high-pressure line, the escaping stream is confined to the conduit and the pavement or roadbed protected from damage. Where the necessary provisions are made, this method also allows ready access to the main for the purpose of making repairs.

The passing of another year of service has brought additional evidence of the economies of Armco paved-invert pipe, the result of the first successful effort to incorporate the principle of balanced design into drainage structures. In this product, the bottom or invert of the pipe, which the investigation of thousands of culverts of all types has shown to receive the greatest wear, is paved with a special bituminous material which protects the invert from erosive action of abrasive materials that are carried by the water. With the exception of the pavement, Armco paved-invert pipe is the same as the regular Armco corrugated-iron pipe which has completed its twenty-fourth year of continuous service.

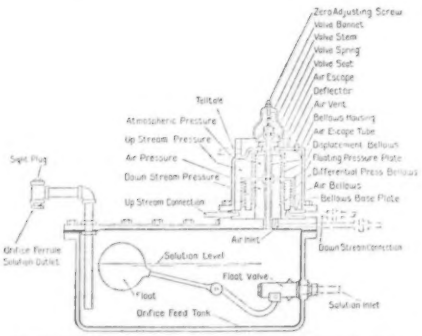
Because of the lightweight continuous construction of this type of pipe and its service-proved strength and durability, municipalities are finding in it a quickly installed and economical storm sewer. Special economies are obtained by its use for outfalls and other purposes where unstable soil conditions would necessitate special foundation work for the heavier, rigid types of construction.

Full information on the Armco jacking method of installing conduits and the uses and economies of Armco paved-invert pipe may be secured upon request from the Armco Culvert Manufacturers' Association, Middletown, O.

Interior of Armco Paved-Invert Culvert

Cochrane Products for the Treatment of Water

Accurate proportioning of one fluid to another is required in various processes, as, for example, the softening of water. Devices are in use in which the primary stream and the secondary



Cross-Section of Cochrane Air-Balanced Proportioner

stream are each measured by means of the pressure differential due to flow of the respective streams through an orifice, the two pressure differentials acting upon a balance by which the flow of the secondary fluid is controlled automatically. In some instances, however, the fluid to be controlled may be corrosive, or otherwise of such a nature that it is not desirable to have it come into direct contact with the diaphragms or pistons of the balancing mechanism.

The air-balanced proportioner shown herewith has been developed by the Cochrane Corp., Philadelphia, Pa., to overcome this difficulty. Referring to the sectional view, it will be seen that the corrosive solution is held at a constant level in a feed tank by means of a float-regulated valve which controls inflow from a source of higher pressure, while the outflow of the corrosive solution is through an orifice. The pressure acting upon the outflow orifice is determined by the air pressure above the liquid level in the solution tank, this pressure being regulated automatically as described below.

Mounted upon the solution tank is a balancing device consisting of three corrugated bellows, all attached to a single movable diaphragm which carries on an axially-placed tube a valve member co-acting with a stationary valve member at the top. The surface of the diaphragm contained within the inner pair of bellows is acted upon beneath by the air pressure within the feed tank, while the upper surface is open to the atmosphere. The annular portion of the diaphragm outside of the inner bellows and within the outer bellows is acted upon on its upper surface by the pressure from the upstream side of an orifice in the primary flow pipe and upon its under side by the pressure from the downstream side of the same orifice.

The differential due to the flow of the primary liquid is thus balanced against the pressure within the orifice feed tank. Should the latter be greater in proportion than the differential due to the primary flow, the valve member will rise and allow some of the air in the orifice solution tank to escape. On the other hand, should the differential pressure be the greater, the orifice member will fall so that no air can escape; but inasmuch as air is constantly flowing into the solution chamber from a supply source, the air pressure will build up until the valve will again be lifted. In other words, in operation the valve is always leaking more or less and the pressure within the orifice feed tank is always proportional to the differential due to flow of the primary liquid. The rate of inflow of air into the orifice feed tank is through a small orifice in the supply pipe. If the pressure of the source from which this air is taken is roughly more than twice the highest pressure carried in the orifice feed tank, the rate of inflow will be constant.

From the sectional drawing it may be seen that the entering air first flows into the space within the lower inner

Cochrane Proportioner for Corrosive Solutions

bellows and then downward through the clearance around the tube attached to the diaphragm and serving both to guide the diaphragm and to carry the valve member. The outflow of air to the valve takes place up through this tube. There is thus no opportunity for acid vapors to penetrate into the bellows chamber and attack the bellows; also, most of the air flowing out through the valve will be fresh incoming air and not acid-laden.

When the apparatus is put into operation, a spring bearing upon the top of the movable tube is so adjusted that pressure will be held in the orifice feed tank just sufficient to raise the acid solution to the level of the outflow orifice when there is no differential pressure from the primary flow pipe. The flow through the primary flow pipe causes a differential loading to be applied to the bellows which increases as the square of the rate of flow. An equivalent opposing air pressure will at the same time be built up in the feed tank and the flow of acid out through the orifice will vary as the square root of this air pressure, and will, therefore, be directly proportional to the flow of the primary fluid. The outflow through the orifice takes places into an open funnel, so that it can readily be inspected.

The tank from which the acid solution is received may be located below the air-balanced proportioner and the acid lifted up to the latter by admitting pressure from the primary air supply to the solution tank. Similarly, the latter may be fitted with a calibrated measuring tank and with air pressure connections so that acids can be charged into the solution tank without releasing the pressure on the latter. The supply for the proportioner may be also obtained from an elevated tank or by means of a constantly-running centrifugal pump if desired.

To secure good mixing in the solution tank, various agitating means may be used, one frequently used consisting of a perforated air pipe. In other cases mechanical agitators may be employed.

Another Cochrane development is a de-aerator, designed especially for protecting the piping of hot-water heating and service systems from oxygen corrosion. Briefly, the process employed comprises the following steps:

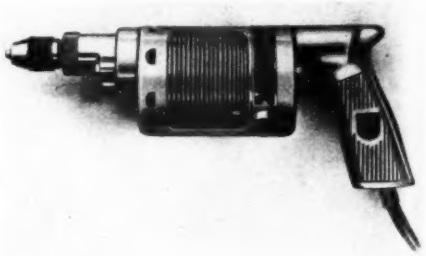
1. The water is heated to the temperature at which water boils under the total pressure of the atmosphere which is actually in contact with the water.

2. The water is distributed over trays and agitated, thus increasing the area of the liberating surface from which gas may escape.

3. The atmosphere in contact with the water is continually removed and replaced by pure steam in order to carry away the liberated gases through a vent.

New General-Purpose Drill by Goodell-Pratt

The Goodell-Pratt Co., Greenfield, Mass., has recently brought out a ¼-in. general-purpose electric drill which has some unusual features. It is powered for a ¼-in. general-purpose drill by a Westinghouse motor. The spindle is full ball-bearing and the gears are made from heat-treated alloy steel. Ample ventilation is provided, the air



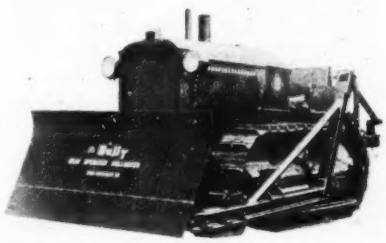
Goodell-Pratt ¼-In. General-Purpose Electric Drill

being drawn from the back of the housing up through the pistol-grip handle. This keeps the drill cool and comfortable to use with either one or two hands. Ribbed panels on the handle and housing afford a good grip to the operator and at the same time act as cooling fins. The switch handle is a rubber-covered ball, placed to be easily controlled by a flick of the thumb. The brushes are set at an angle so as not to interfere with close drilling in corners. The drill is rated for ¼-in. work in iron or steel, and the manufacturers state that one man cannot stall it by any legitimate means. It weighs 4¼ lb.

Gear-Operated Bulldozer for Monarch Tractors

A new gear-operated bulldozer has been designed for use with Allis-Chalmers Monarch 50 and 35 tractors by Niess & Co., Inc., of Minneapolis, Minn.

This bulldozer is made in two types, the bulldozer with rigid blade and the backfiller with adjustable blade. The



New Gear-Operated Bulldozer for Monarch Tractors

adjustable blade is set unusually near the front of the tractor and is supported and propelled at both ends, a feature which greatly reduces side draft.

The power-transmission unit, composed of pinion and bevel gear, together with spur pinion and gear segment, is employed in connection with a Twin Disc clutch and brake. Gears are enclosed in an oil-tight housing attached to the transmission case of the tractor, while the clutch and brake are mounted on the outside of the gear case to be readily accessible.

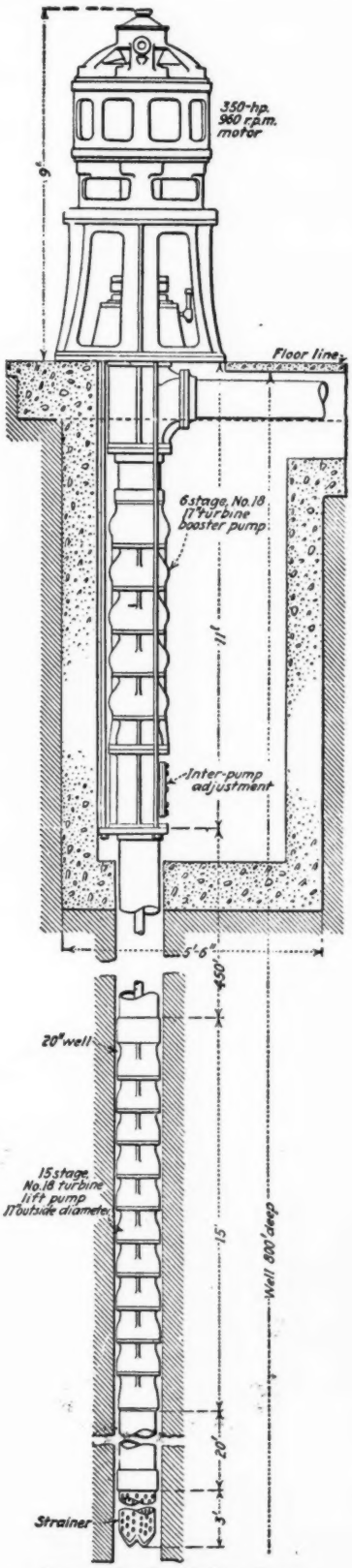
Advantages of the gear-operated bulldozer include fast and positive action of the blade, a wide travel radius of the blade and additional clearance when high obstructions are encountered. The blade is controlled by a single lever and can be locked in the ground or allowed to float.

Anti-friction bearings are used in the transmission unit, and all moving parts are set on lubricated bearings. Electric welding is employed throughout.

Attaching this bulldozer to a Monarch tractor does not interfere with the use of other equipment on the drawbar.

Pomona Duplex Turbine Pump Finds Favor

The modernization of water production methods has developed many new and important pump types. Among these newer pumps one of the most advanced designs is what is known as the duplex turbine type. Hydraulic engineers have shown great interest in this mechanism because of its efficient operation even at depths as great as 1,000 ft. in drilled wells.



Pomona Duplex Turbine Pump

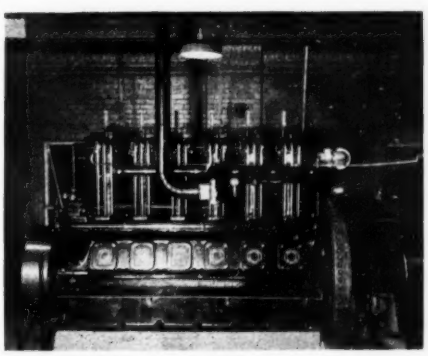
Pumping from the water level in a drilled well to the surface or pumping from the water level of the well to an elevation high above the ground level is effectively accomplished by the duplex turbine pump, according to the manufacturers. In the first case, the upper set of stages is installed midway between the surface and water level of the well. When part of the lift is above ground the upper stage assembly is placed directly under the pump head. The outline drawing shown here is of the latter style.

The independent booster pumps ordinarily used are eliminated. Greater operating economy is claimed to be the result of using but one motor and one starter. Power consumption is reduced from 15 to 25 per cent, according to engineers. Both groups of stages are driven through the same pump shaft by the same motor. Thus speeds are identical and capacities are synchronized.

"The demand for this style of equipment," according to W. H. Day, vice-president and general manager of the Pomona Pump Co., manufacturers of this type of pump, "was foreseen by our engineers several years ago and experimental work was started at that time. This dual pumping principle, combined into one unit, is finding favor in many districts where very deep lifts are encountered and eliminates the necessity of booster mechanism."

Chicago Pneumatic Engines in Water-Works Service

Engines of the Chicago Pneumatic Tool Co. have been installed in a number of water-works plants throughout the country. The type RHG-40 shown in the accompanying illustration drives an Aldrich triplex pump in the Beaver, Pa., plant. The pump has a rated capacity of 2 m.g.d. against a total head of 460 ft. The engine is rated at 198 b.hp. at 260 r.p.m. Natural gas is used for fuel.

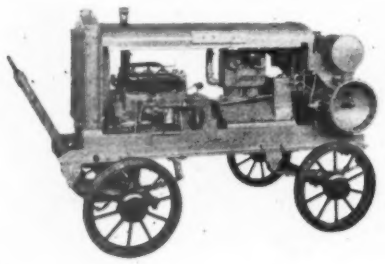


Chicago Pneumatic Engine at the Beaver, Pa., Water Works

Sullivan Adds Small Vibrationless Compressor

The accompanying photograph shows a new addition to the Sullivan line of "vibrationless" portable air compressors.

This is the 66-ft. machine, the smallest size thus far manufactured, which



Sullivan 66-Ft. Portable Compressor with Rubber-Tired Wheels and Spring Mounting for Use on City Streets

compares with the 110-ft. Sullivan compressor in general appearance and construction. This new size finds a place among contractors, public utilities and municipalities who have a variety of jobs to perform from time to time requiring small amounts of compressed air.

The 66-ft. WK-312 compressor has two vertical cylinders, 4¾x4 in., run by a 4-cylinder, 18-hp. gasoline engine, direct-connected, and is good for 100 lb. pressure. It can be furnished with steel wheels, on which it weighs 2,500 lb.; on spring mounting with rubber tires, as shown in the picture; on skids, or on a two-wheel trailer.

In design, construction and operating equipment, this unit is merely a smaller member of the well-known Sullivan portable line, and the same performance as from larger Sullivan compressors is being secured with the "baby" of the family. This new compressor is described in a new 40-page air-compressor bulletin distributed by the Sullivan Machinery Co., Chicago, Ill.

Media for the Coli Test

The presumptive test for B. coli is of vast importance to all who are concerned with the safeguarding of water supplies. The colon bacillus is the indicator of pollution and sounds the warning of danger of epidemic outbursts of intestinal disease. Typhoid, enteritis and dysentery in all their forms are water-borne infections indicated by the presence of B. coli.

A rapid and accurate method for detecting the colon organism is a necessity to any worker in a water-works laboratory. Many cultural methods and tests have been proposed for this specific purpose. Some of these methods have come into quite general use.

Bacto brilliant green bile 2 per cent, developed by the Digestive Ferments Co., Detroit, Mich., at the suggestion of Committee No. 1 on Standard Methods of the American Water Works Association, has met with the approval of many laboratory workers. This dehydrated medium is simple to prepare and yields uniform media with which comparable results are assured. The growth of the gram-negative, non-spore-forming, lactose-fermenting organisms of the colon group in this medium indicates recent pollution. The growth of spores and other organisms capable of fermenting lactosa is inhibited. The confusion which such organisms might cause in the interpretation of results is greatly reduced.

Baco lactose broth is another product manufactured for the laboratory worker seeking evidences of pollution. This product, when made up for use, yields a medium conforming in every way—ingredients, formula, reaction—to the requirements of "Standard Methods of Water Analysis" of the American Public Health Association. Lactose broth prepared according to these standards is the official medium for the detection of B. coli in water. Bacto lactose broth, in its dehydrated form, is a stable and uniform product, easily made up for use; and yields a medium identical in every way with the official medium.

Bacto brilliant green bile 2 per cent and Bacto lactose broth are both extremely useful to the bacteriologist in the water-works laboratory. For the routine examination of waters which are ordinarily quite free from contamination Bacto lactose broth is recommended. In cases where a water supply is liable to pollution or contamination, the presence of non-intestinal organisms frequently causes confusion and delays the interpretation of results. In such instances it is sometimes preferable to use a partially inhibitory medium such as Bacto brilliant green bile 2 per cent.

Further information about these and other media useful to the water-works bacteriologist will be furnished by the Digestive Ferments Co., Detroit, Mich.

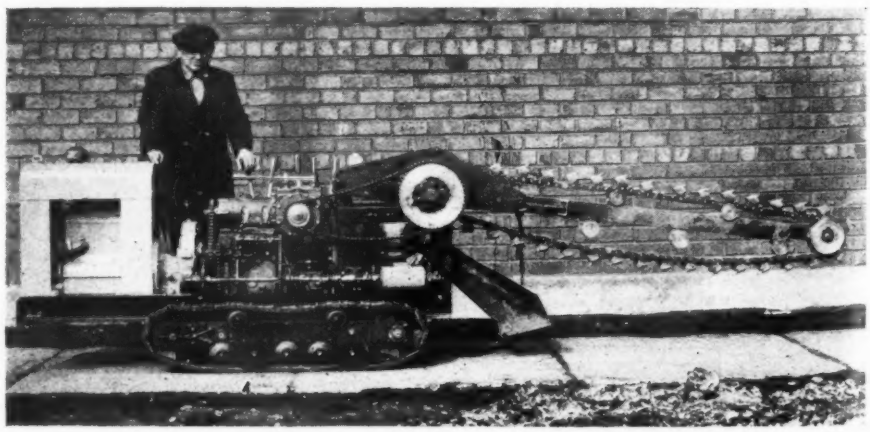
New Motor Housing for Turbine Centrifugal Pump

Since the introduction of turbine centrifugal pumps requiring vertical motors, no concerted attempt has apparently been made to design the motor housing as an integral part of the pump, according to H. G. Steele, president of the U. S. Electrical Mfg. Co., Los Angeles, Calif. Heretofore, the base of the pump, resting upon the concrete at the surface of the ground, was designed by the manufacturer to meet his needs and when the motor was set upon the pump, according to Mr. Steele, sometimes an awkward assembly that was both ugly and not in keeping with good engineering practice resulted.

U. S. Electrical engineers some time ago began the study of electric-motor construction as applied specifically to turbine centrifugal pumps, and finally developed a new motor housing which will be known as the U. S. Turbo pump motor. None of the operating units is exposed and the motor is said to be weatherproof. It is designed with the operating parts fully protected and is symmetrical. When set upon the pump base it is said to offer a very pleasing appearance.

C. H. & E. Trench Digger Announced

The accompanying illustration shows a new trench digger developed by the C. H. & E. division of the National Equipment Corp., Milwaukee, Wis. This outfit, which has been undergoing development for the past two years, will cut a trench from 3 to 6 in. wide and 4 ft. deep. Many uses for this machine in the water works and sewerage fields will suggest themselves. The bucket boom is operated by hydraulic lift, as in a motor truck, and the outfit is crawler-mounted. Two speeds forward and one reverse are provided. The machine will dig a trench 3 in. wide and 3 ft. deep at the rate of from 4 to 6 ft. per minute. Power is furnished by a 10-hp., 4-cylinder Fuller & Johnson engine.



New C. H. & E. Trench Digger

Miami Front-End Shovel for Caterpillar Tractors

A new piece of equipment produced by the Miami Trailer-Scraper Co., Troy, O., is the Miami front-end shovel for Caterpillar tractors, models 10, 15 and 20. This shovel is furnished complete,

Miami Front-End Shovel for Caterpillar Tractors

as illustrated, no extra tractor parts being required in setting up. Its capacity is 8 to 9 cu. ft. for the model 10, ½ yd. for the model 15 and ¾ yd. for the model 20.

The shovel is constructed of high-carbon plate, strongly reinforced by angle irons. The overhead cable-carrying frame is hinged to the tractor treads to equalize these treads in operation. The operating cables provide for an equal lift on each side beam. A short-circuiting device is provided so that the shovel may not be raised above a stated maximum height. The shovel bucket is dumped by means of a dumping lever and rope, the shovel then being lifted to its original position by a righting lever and rope.

The unit interchanges with the Miami bulldozer. In changing to bulldozer equipment it is necessary only to remove the two operating cables and four bolts where the shovel attaches to the extended axle in the tractor. The unit also interchanges with the Miami backfiller, providing excellent equipment for the contractor engaged in sewer or pipe-line work. Three power operations are available with a single tractor and power winch.

Py-Lubro in the Water-Works Field

Py-Lubro is a compound recently introduced in the water-works field, especially prepared to prevent corrosion and to provide at the same time a lubricant to permit of instant separation or rotary movement of the parts so protected. Typical of its uses is the protection of a valve which, though seldom used, must be opened immediately when desired.

The corrosive action of water in distribution systems may be combated satisfactorily by the use of Py-Lubro on exposed frictional parts. According to the manufacturers, the Py-Lubro Co., Philadelphia, Pa., fire hydrants and valves assembled with Py-Lubro last longer and work easily. Packings well saturated with this compound may be depended upon to operate easily for a long period, it is stated.

Py-Lubro, the manufacturers state, is impervious to the weather and to heat, slow to break down under chemical action and equally slow to wear out under friction. It has the consistency of lard and is as easily applied as any grease.

Apparatus for Analysis of Water and Sewage

The accurate analysis of water, sewage and industrial wastes always has been an important factor for water and sanitary engineers. Until a short time ago the colorimetric tests were hindered by the inconvenience of preparing and rechecking the liquid comparison standards, which are said to fade more or less in the course of time. The accompanying illustration shows a water-test comparator with permanent color-glass standards, made by the Hellige-Klett Co., New York, N. Y.

Hellige Comparator and Glass Standards

The Hellige comparators for water analysis, hydrogen-ion control and many other tests have cells or tubes with plane and parallel walls and a prism arrangement which brings the color fields into juxtaposition. It is stated that working with these comparators is very simple and that tests can be made without any special training after a few minutes' reading of the directions. No readings from tables or calculations are necessary. The color disc is just revolved until a standard matches with the test solution and the result read directly by a number appearing through an opening in front of the apparatus.

In addition to the color-glass standards for the analysis of water, sewage and industrial wastes, permanent color-glass standards are available for hydrogen-ion control and many other tests.

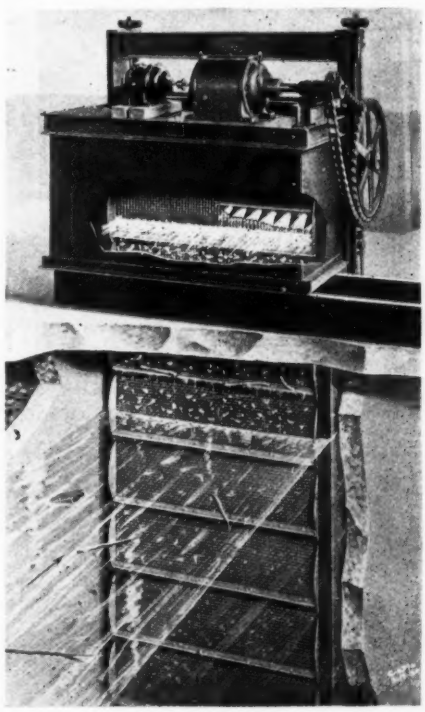
New Traveling Water Screen

A new type of traveling water screen embodying many features has been put on the market by the Chain Belt Co., Milwaukee, Wis. While the general principle of traveling water screens is retained, the outward appearance of the screen itself has been definitely changed. It will occupy less space than heretofore. Another of its improvements is its accurate sealing and operating features.

The two major improvements consist of a new basket design and a new base.

These rectangular baskets hold the screen cloth (which may be of various constructions) and are in turn carried by two strands of Rex Chabelco hardened-steel roller chain. The chain operates over head and foot sprockets. As the submerged screen surface becomes matted with the refuse, the screen is revolved. The refuse is then lifted from the intake by the upward travel of the baskets and is automatically removed by means of a powerful spray of water directed through the baskets from their rear, which washes this refuse into a refuse trough. The spray of water serves to sluice the screen material away for disposal, usually on the downstream side of the plant.

The second major improvement is the radically new design of the foot wheel, which permits the use of the new extended track shoe. This shoe engages the roller at the exact instant that it leaves the wheel. There is no intervening space in which the roller can weave inward, causing openings between the ends of the baskets and the frame of the screen.



Chain Belt Traveling Water Screen

Pardee Ammonia Control Unit

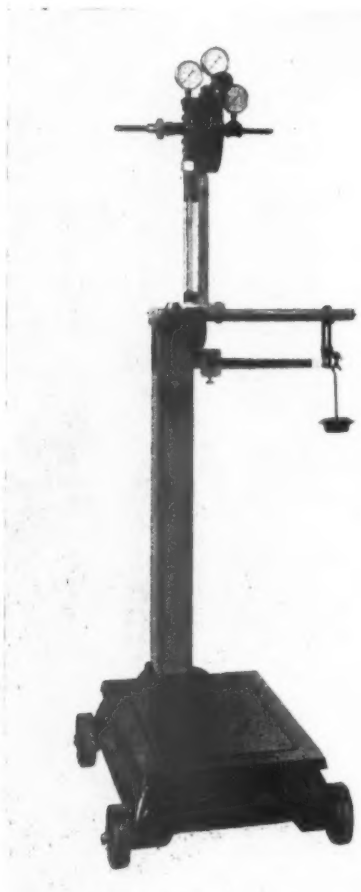
The type 13 ammonia control unit manufactured by the Pardee Engineering Co., Long Island City, N. Y., is a device for controlling accurately the flow of anhydrous ammonia gas. It is easily adjusted to deliver the desired flow; once adjusted, it maintains this flow automatically until readjusted. Changes in supply or discharge pressure do not change the rate of flow through it. It consists essentially of a control valve which adjusts the flow, two diaphragm valves which maintain the flow and auxiliary gauges to aid in operation.

The total capacity range of this unit is from 0.02 to 200 lb. of ammonia a day. The capacity of a particular unit is limited by the meter in use. A bubbling meter covers the capacities from 0.02 to 1 lb. a day. Orifice meters with calibrated scales are provided for the larger sizes. Two or more orifices of different sizes can be had for the same unit. Meters are interchangeable, so that any unit can be changed to any capacity by inserting the proper orifice and scale and changing certain valve stems and seats.

The unit can be mounted on a short gray enameled stand attached to the arm of the platform scale on which the cylinders are placed. In addition, a gray enameled floor stand and a bracket for attachment to the wall or a pipe are available. This choice of mountings allows the unit to fit into nearly any plant condition.

This unit is simple and strong. The different devices comprising it have been condensed into a single unit of few parts. Joints and connections have been reduced to a minimum. The gas flows continuously through every part of the apparatus. There are no dead ports or passageways to foul and plug up. Internal threads have been avoided wherever possible.

The unit is built of cast-iron and steel entirely. For the important valve parts, stainless steel is employed. The unit is finished in black pyroxyline enamel with chromium plating and polished trim. The scale is of white pyroxyline with black markings covered with pyroxyline. It will remain white and readable. The unit is easily operated and read, easily cleaned outside and in and easily maintained. Any good plant mechanic can take it apart and make replacements and repairs without danger of breakage or loss of accuracy. It will stand rough handling.



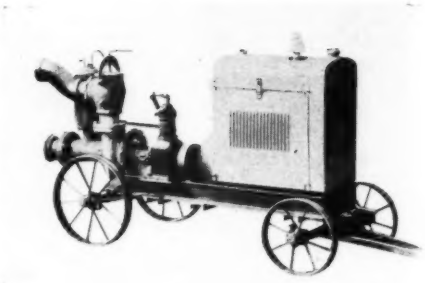
Pardee Ammonia Control Unit

A New Self-Priming Pump

Much interesting development and research work has centered around a new self-priming centrifugal pump that the Chain Belt Co., Milwaukee, Wis., has recently put on the market. C. I. Longenecker, engineer for the company, who has spent the greater part of his life designing pumps, developed this new pump which, it is said, takes practically all the air out of the chambers and maintains its prime.

The new pump is in addition to the line of pumps the company now manufactures and is a part of the line of construction equipment consisting of concrete mixers, pavers, saw rigs, central mixing plants, etc. No matter whether the depth of the hole is 27 in. or 27 ft. and regardless of what the amount of water may be, the pump will keep its prime with greater lifting capacity. On many pumping jobs there are times when very little water is in the hole—in fact, barefuly a cupful. This may be the case one minute, and the next water may rush in and fill up the excavation. The pump used on the job must be ready to take care of the increase of water without any attention.

The new self-priming centrifugal requires no attention even though the water does go below the end of the hose. The vacuum is maintained automatically and the pump needs no priming. Just as soon as the water begins to drop the vacuum pump begins to exhaust the air and pick up the prime again. Ordinarily there are air pockets at the hub of the centrifugal vanes. These pockets interfere and many times destroy the prime. In the new self-priming centrifugal, Mr. Longenecker has made it possible to remove these air pockets before they can be sealed.



C. H. & E. Self-Priming Centrifugal Pump

Transit System of Concrete Production

The Paris Transit concrete mixer, manufactured by Transit Mixers, Inc., San Francisco, Calif., consists of a revolving mixing drum, constructed to be mounted on a truck, deriving the power for rotating and tilting the drum from the truck engine.

The drum is cylindrical in shape, having a cone or apex end for receiving the components and discharging them mixed. The inside of the drum is provided with a series of baffle plates and bars, insuring a complete distribution of the mix as the drum rotates. Water tanks, consisting of one main tank and one reserve tank, are installed at the top of the mixer. The water is sprayed through a feeder piper in the center of the drum, and the volume is automatically controlled.

Transit mixers are built in sizes to suit standard makes of trucks and have capacities up to 5 cu. yd. Sizes to meet all weight restrictions, as well as the needs of any operator or community, are thus supplied.

Essentials in the Paris Transit system of concrete production are (1) proper provision for accurate measurement of aggregates and cement; (2) complete dry mixing of aggregates and cement; (3) a system for measuring accurately and adding an exact quantity of water, and a means of effecting a complete mixture of the whole; (4) a system of operations that will insure delivery of the completed mix exactly

Paris Transit Mixer

where, when and in the quantity wanted without segregation, and (5) a method of mixing while discharging that delivers the mix in perfect form for work—either in stiff or wet mix.

Lawrence Non-Clogging Sewage and Trash Pumps

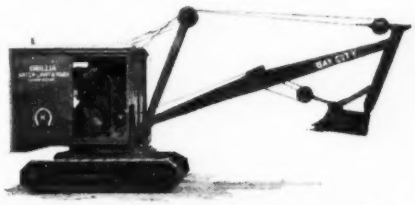
The accompanying illustration shows a Lawrence Vortex Sureflo non-clogging sewage and trash pump, manufactured by the Lawrence Pump & Engine Co., Lawrence, Mass. The special impeller design of this pump contributes to the satisfactory handling of large solids, trash, rags and stringy material without clogging and without screening. Large handholes are provided at the pump suction so that any material too large to enter the pump casing can be removed readily. Heavy construction throughout gives long life under severe operating conditions. This pump can be furnished with all parts coming in contact with the liquor handled made entirely of iron, bronze, monel metal or stainless steel. Special wear-resisting alloys are available for handling abrasive material.

This pump may be had in a horizontal model with the same special casing and impeller design.

Vertical Model of Lawrence Sureflo Non-Clogging Pump

Bay City Announces Special Trench-Type Boom

Bay City models R and K full-revolving machines are now available with special heavy-duty trenchoe equipment, with an electrically-welded boom. This construction is shown in the accompanying illustration. These machines have previously been constructed with a convertible skimmer-ditcher boom which could be used for the operation of either skimmer-type bucket or trenchoe. The manufacture of the convertible boom will not be discontinued and it will still be available for contractors who are doing both skimmer and ditcher work.



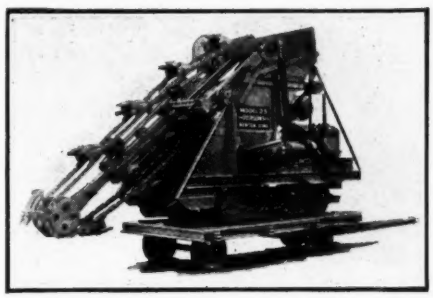
Bay City Model K with Special Trench Boom

The special type of trench boom illustrated is a better type of boom to use for trench work and will be furnished to purchasers who are interested primarily in trenching and open-ditch work. It cannot be used to operate a skimmer or any other bucket. When using the special trench-type boom as illustrated, it is possible to eliminate the extension mast which is necessary for skimmer work. The base of the special hoe boom is mountd on the unit cast revolving table. The semi-vertical mast is designed so that it can be reached or lowered to reduce the overhead clearance of the machine for passing under bridges, overhead railroad crossings, etc.

New Parsons Ditcher

A new ditcher, the model 25, for medium-sized jobs, built according to Parsons patented offset design on full-crawler traction, has been brought out by the Parsons Co., Newton, Iowa. This machine fits right into the Parsons line of patented offset-boom full-crawler machines—coming naturally between the 21, which is designated for lighter trench work, and the 31, which handles the heavier water and sewer jobs.

The 25 contains several advanced features which are claimed to be of particular advantage to a machine of this size:



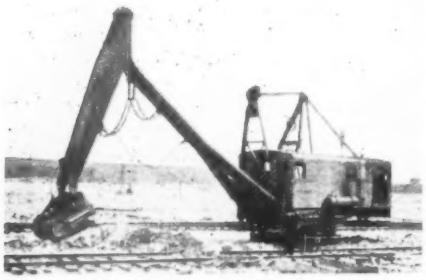
Parsons Model 25 Ditcher

1. Two bucket speeds which, synchronized with the four traction speeds, enable the operator to show large output and save power.
2. Two speeds on conveyor, to adapt it to yardage load at various ranges of digging.
3. Full-crawler mounting on an improved three-point suspension.
4. Enclosed transmission with ground shafting, heat-treated gearing and roller bearings. This single transmission contains every operation, including traction speeds and reverse, conveyor drive and reverse, boom hoist and reverse, bucket drive and reverse—a compact working unit, fully protected in an oil-tight case.
5. Conveyor frame of extra heavy construction, to meet severe digging conditions.
6. Boom hoist through shaft equipped with flexible couplings and connected to pull directly on the roller carrying the boom carriage.

Because of its compactness, the Parsons 25 is easily handled and easily moved from job to job. Where jumps are long the machine rolls quickly up on to a trailer.

Page Drag Shovel Attachment

A 1½-yd. drag shovel recently announced by the Page Engineering Co., Chicago, Ill., brings a new tool to the service of the water-works contractor. This machine covers a radius of 55 ft., digs to a depth of 28 ft. and can dump into a hopper 20 ft. high. Although



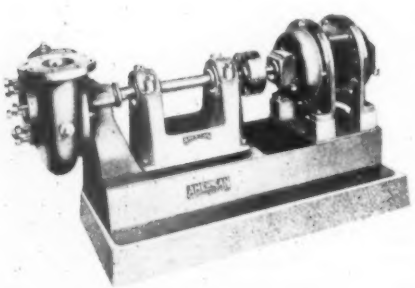
Page Walking Dragline with Page Drag Shovel Attachment on a Difficult Excavation Job

it digs with steam-shovel aggressiveness, it handles like a dragline, loading equally well above or below the machine level. The bucket is under close control and will carry a flat bottom in the deepest trench or grade a slope with precision, either toward the machine or away from it. It always gets a load, which it carries without spilling to the spoil bank, truck or car it may be loading. This product is offered as a standard attachment for several of the better known draglines from ½ to 2-yd. capacity.

The accompanying photograph shows a Page walking dragline with the Page drag shovel attachment at work for Dowdle Bros. on their contract for the Illinois Steel Corp., Chicago, Ill. The excavation for the footings of the new beam mill is through 18 ft. of heavy slag and furnace bottoms.

American Well Works Two-Port Sewage Pump

The American Well Works two-port sewage pump is a new departure in sewage-pump design. The two-port impeller with which these pumps are equipped permits the handling of unscreened sewage. This makes unnecessary the installation of expensive screens or the usual high maintenance cost necessary if screens are to retain their effectiveness. This pump is also appliacable for use in boosting raw sewage from low to higher levels, obviating expensive sewage construction in many instances.



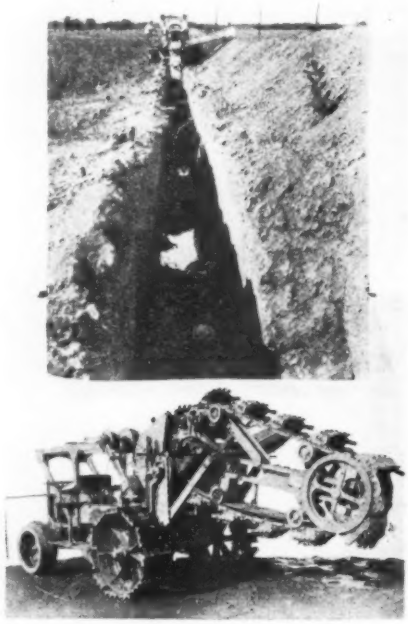
American Well Works Two-Port Sewage Pump

This pump is made in both vertical and horizontal types and in a wide range of sizes and capacities. Large hand holes are conveniently placed in the volute for the inspection of the interior of the pump, and thrust bearings of the ball-bearing type are provided. Vertical pumps are furnished either with or without steel framework, and are also furnished either with or without closed line shaft.

On vertical pumps the bearing immediately above the pump is of the split type. It may easily be removed, permitting access to the interior of the pump, without disturbing pipe connections.

Topping Pony Ditcher

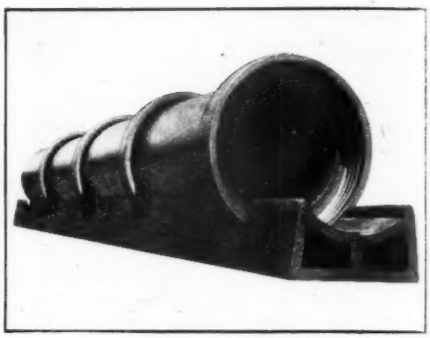
The Fordson model of the Topping pony ditcher is particularly well adapted to trenching for water lines, small sewers and other conduits of small dimensions. This machine replaces heavier and more cumbersome and costly ditching outfits, effecting desirable economies in work of the nature indicated. The Fordson power unit offers ample power for traction, digging and operation of the various levers. The machine has 17 forward speeds and 9 reverse. Only one man is required for operation. Many water-works boards have found it profitable to include Toppings among their equipment for use on small and large jobs. The Topping will dig trenches from 13 to 24 in. wide and up to 7 ft. deep.



Topping Ditcher: Close-Up and in Action

Ric-wiL Sewer Products

Ric-wiL cradle base for sewers is made of heavy vitrified tile in a design which supports and strengthens the sewer pipe. It is flat on the bottom which is the full width of the pipe, and the top is shaped to cradle the pipe, with slots for the bells. It forms a solid foundation and grades, aligns and centers the pipe automatically. It gives effective drainage in wet going and is said to speed the work of installation materially. The design of the cradle adds an average of 82 per cent to the crushing strength of the pipe supported, the manufacturers state.



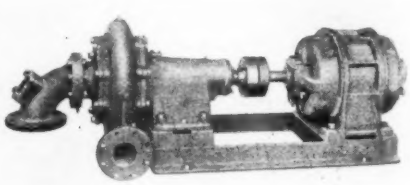
Ric-wiL Cradle Base

This cradle base is made for all diameters of sewer pipe, up to and including 18 in. It is made in 2-ft. sections for 2-ft. pipe, 15-in. sections for 2½-ft. pipe and 18-in. sections for 3-ft. pipe. Special sizes are available for larger pipe.

Ric-wiL sewer-joint compound is made from specially-selected asphalts, refined and blended. The lighter oils are removed and a powdered, acid-resisting filler is added. The mixture melts at moderate kettle heat and cools rapidly. According to the manufacturers, this compound assures watertight joints, preventing infiltration and conserving the full capacity of the pipe for sewage. The joints are flexible enough to conform to movement caused by settlement.

Worthington Freflo Pump for Unscreened Sewage

The Freflo ball-bearing centrifugal pump, placed on the market within the last few months by the Worthington Pump & Machinery Corp., Harrison, N. J., is designed especially to handle unscreened sewage.



Worthington Freflo Pump, Direct-Connected Horizontal Type

Among the important features of this design is the complete elimination of a stuffing box by the use of a sylphon air and water seal. This design reduces considerably the overhang of the shaft. The design of the impeller used in these pumps is original with Worthington and is based on the results of exhaustive tests. The impeller is of wide sections and will pass solids, trash and stringy material without clogging the pump. Standard impellers are made of cast iron, but impellers of bronze will be furnished when required by conditions.

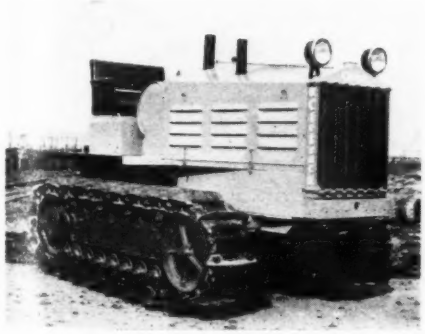
The Freflo pump is fully standardized, and many of the parts are interchangeable in pumps of different size and type. Arrangements for all the accepted methods of driving are provided; horizontal type for direct connection to electric motors or internal-combustion engines, belt drive from prime movers or line shaft and vertical shaft drive. The horizontal pumps for direct drive are mounted on structural steel base plates as shown in the illustration. The belt-driven pumps can be mounted directly on a concrete pedestal. Two arrangements are provided for vertical shaft drive, a self-contained unit with base elbow and a bracket as used on the horizontal model.

80-60 Cletrac a New Product

The new 80-60 Cletrac, a product of the Cleveland Tractor Co., Cleveland, O., was first shown to the public at the Atlantic City convention and show of the American Road Builders' Association last January.

The over-all width of the tractor over the track is 96 in. and the over-all length is 156 in. The height from ground to top of radiator is 82 in. The ground clearance between the lowest part of the drawbar and the ground is 15 in. without grousers; with grousers it is 18 in. The tread of tracks is 67 in. center to center; the width of tracks is 17 in. The width of grousers is 20 in. and the track length (ground contact) is 97 in. This gives a ground contact of 33 per cent of the total length of track.

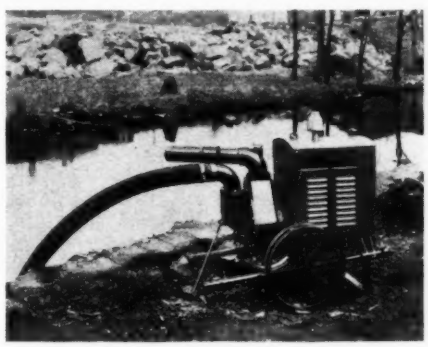
The 6-cylinder engine has a 5½-in. bore and a 6½-in. stroke, with 927 cu. in. displacement; it is governed at 1,050 r.p.m. It develops 119 b.hp. and 645 ft.-lb. torque. The engine is equipped with 12-volt Delco-Remy starting and lighting and single ignition, Purolator oil cleaner and A-C breather. The clutch is an 18-in. pull-type Borg & Beck. The transmission is of the selective type and gives three speeds forward and one reverse. At 1,050 r.p.m. engine speed the tractor speeds are 1¾ m.p.h. in low gear, 2½ m.p.h. in intermediate gear, 3.6 m.p.h. in high gear and 2.1 m.p.h. in reverse.



New 80-60 Cletrac

New 4-In., Self-Priming Homelite Pump

The Homelite Corp., Port Chester, N. Y., announces a new self-priming portable 4-in. centrifugal pumping unit with built-in gasoline engine.



New 4-In. Self-Priming Homelite Pump

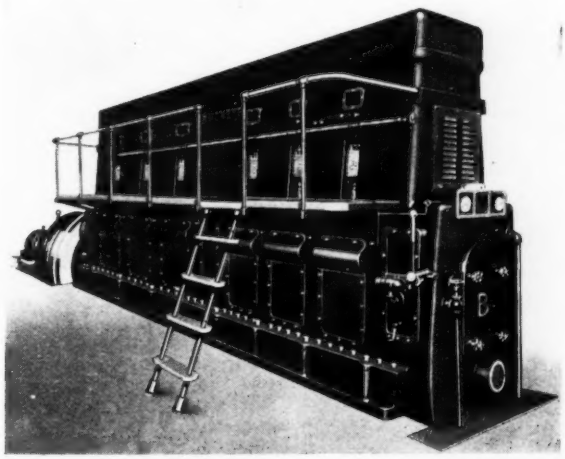
As in other Homelite units, the pump is self-priming without the use of auxiliary pumps or vacuum apparatus. The pump capacity is 25,000 g.p.h. with suction lift of 20 ft. The bronze impeller is of the open type. Powered by a Le Roi 8-10-hp., 4-cylinder gasoline engine, the complete unit weighs 730 lb.

Buckeye Adds Larger Diesels to Line

For the past twenty years the Buckeye Machine Co., of Lima, O., has manufactured internal-combustion engines of the gas, gasoline and diesel type in various sizes. Because of the great demand for the larger diesels they now have added larger vertical diesels to this line.

The vertical Buckeye operates on the four-stroke-cycle principle and is built in sizes of 200 hp. and up to 480 hp. in 3, 4, 5 and 6-cylinder units. The piston is 13 in. in diameter and has an 18-in. stroke, which develops 65 hp. per cylinder at 300 r.p.m.

Features of the engine are as follows: removable cylinder liners; new air intake, designed to give a highly turbulent cylinder charge; built-in air filters; fuel-oil filters and lubricating-oil filters. Cylinder heads are removable without disturbing exhaust manifolds, air pipes, springs, etc. Pressure lubrication is used throughout and all parts are fully enclosed, as can be seen in the illustration.



New Buckeye Vertical Diesel

Automatic Primer Co. Products

The American chlorinator, recently introduced by the Automatic Primer Co., of Chicago, has already come into extensive use. It employs the dry-feed method, which has proved thoroughly satisfactory for the sterilization of water supplies, swimming pools, sewage, etc., the gas being fed from convenient cylinders of compressed chlorine through the chlorinator and a glass tube leading into the water-supply feed pipe or reservoir, as local conditions require. Features of the device are strength and simplicity of construction and a special measuring control designed for maximum accuracy and dependability.

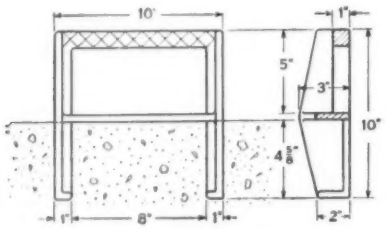
Where the accumulation of gas or air hinders the flow of liquids, Apco automatic air-relief valves, made by the Automatic Primer Co., provide an inexpensive and efficient remedy. They seal on liquid, but pass gas both in and out, and are used to prevent binding in pumps, pipe-line summits and various types of tanks and vessels. These valves are made in three styles and a

complete range of sizes, for pressures of from 10 up to 500 lb., and for venting from 3 to 400 cu. ft. of gas per minute. Multiple installations take care of larger requirements. One model can be used advantageously on city water mains, as it is specially constructed for piping systems in which the gas to be vented collects in large quantities at pressures of 200 lb. or more.

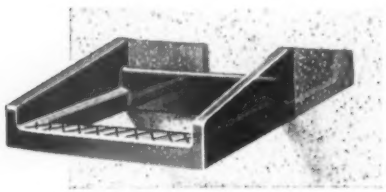
By inserting a vacuum ball in the head, any of the valves can be made to pass out but not in. All models are simple and compact, and operate continuously without attention.

New Clow Cast-Iron Manhole Step

A new product of James B. Clow & Sons, Chicago, Ill., is the A-1670 cast-iron manhole step, shown in the accompanying illustrations. This step was designed by a Chicago engineering firm, and is one which they recommend for use wherever a fixed means of ascent and descent is needed. These steps are made to be embedded in the vertical walls of sewer manholes, catch basins and valve and conduit manholes, and in all other vertical surfaces where dampness and the action of the elements are to be considered. This step can be affixed to either concrete or brick walls. The wide, flat, checkered tread provides a safe footing, while the raised sides prevent the foot from slipping off sidewise in either direction. Considering the long life of the steps and the factor of safety afforded, they find a wide application in the waterworks and sewerage fields.



Dimensions of Clow Manhole Step



Clow Cast-Iron Manhole Step

Chase Copper Tubing for Underground Service

A recent development of the Chase Brass & Copper Co., Waterbury, Conn., is Chase copper water tubing for underground service. The chief advantages claimed for copper water tubing for underground service are freedom from corrosion, and flexibility. There is no contamination of the water. The tubing is flexible and accommodates itself to unevenness and settlement of the soil. Chase tubing has been tested at water pressures up to 2,000 lb. per sq. in. in sizes up to ¾ in. and 1,500 lb. per sq. in. in larger sizes.

Copper service pipes may be installed by the average water department crew. Five tools are required for installation: a wrench, a hammer, a hack saw, a reaming knife and a flanging tool.

An installation is started by unrolling a coil of tubing. This is done by one man. After uncoiling the tubing it is straightened by hand and cut off at the desired length with a hack saw. The burred inside edge is reamed off, a slip nut is placed over the tubing and the end of the tubing is flanged with a Chase flanging tool and a hammer. The fitting is now screwed on to the slip nut. The trench can be filled in as quickly as the installation progresses without danger of injuring the tubing by settling of the ground. Difficult bends are accomplished easily without tools or bending devices. This is an advantage in cases where it is necessary to work around boulders, conduits or other obstacles in the trench.

A line of red-brass fittings for underground service is also manufactured by the Chase Brass & Copper Co.

H T H—Chlorine in Its Newest Form

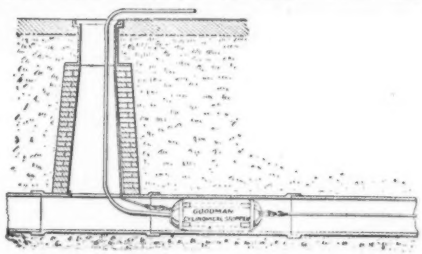
The Mathieson Alkali Works, Inc., New York, N. Y., announces the marketing of true calcium hypochlorite under the trade name H T H, a contraction of the term "high-test hypochlorite." This product is calcium hypochlorite in the form of a dry, stable, highly-concentrated powder. It has never been manufactured before in this country. The development of H T H marks the advent of chlorine in an entirely new form—a true hypochlorite containing 65 per cent available chlorine.

H T H, unlike chlorinated lime, is readily soluble in cold water. It gives up its available chlorine into solution quickly and completely, with a relatively small amount of quick-settling insoluble matter. This results from the fact that calcium hypochlorite itself is readily soluble, as is also the inert material (ordinary salt), while the calcium hydroxide content is very low and is in the form of free lime. The free-flowing character of H T H is also an important factor in its ready solubility.

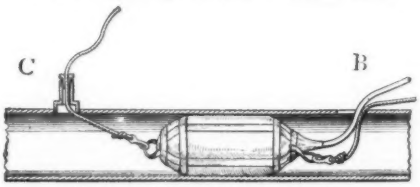
Many phases of municipal sanitation, such as the chlorination of wells and isolated water supplies, the chlorination of newly-laid pipe lines, etc., call for the use of chlorine in compact, concentrated form. H T H has proved a useful ally of liquid chlorine in this field where chlorination is carried on intermittently or on a smaller scale. Among even the larger water works it is sometimes desirable to have on hand a reserve supply of chlorine for use in case of an emergency. H T H is admirably suited to this purpose because of its stability and high concentration.

Goodman Safety Cylindrical Stopper

The accompanying illustrations show the use of the Goodman cylindrical stopper, manufactured by the Safety Gas Main Stopper Co., Brooklyn, N. Y., in sewer and pipe-line work. In sewer work the stopper is dropped into a manhole and allowed to drift with the stream to the desired point, where it is held by the rope and inflated until the flow is stopped. In a water pipe it is inserted through the two small tap-holes and inflated to the proper pressure. The complete operation, the manufacturers state, requires only 1 minute.



Use of Goodman Stopper in Sewer Work



Goodman Stopper in Water Line

Four-Wheel Utility Trailer

The accompanying illustration shows a four-wheel trailer manufactured by the Utility Supply Co., Clintonville, Wis. This trailer is of 5-ton capacity and weighs 4,400 lb. The height of the bolster bed from the ground is 43 in. Bolster stakes are adjustable to give 18 to 46-in. widths. The reach length is adjustable, with five adjustments from 12 to 28 ft. between bolsters. Wheels are of electric cast-steel; springs, front and rear, are semi-elliptic.

Four-Wheel Utility Trailer

Who's Who

Among Manufacturers, Their Representatives and Distributors in the Field of Water Works and Sewerage

J. S. WILSON
Engineer San Francisco Office
American Rolling Mill Co.
Middletown, Ohio

R. C. BEAM
Engineer
American Rolling Mill Co.
Middletown, Ohio

J. C. BROWN
Engineer
American Rolling Mill Co.
Middletown, Ohio

E. C. BRAY
Engineer Philadelphia District
American Rolling Mill Co.
Middletown, Ohio

A. W. BRYANT
Engineer Detroit District
American Rolling Mill Co.
Middletown, Ohio

J. F. COHIG
Engineer Chicago District
American Rolling Mill Co.
Chicago

W. N. CROUT
Engineer Cleveland District
American Rolling Mill Co.
Middletown, Ohio

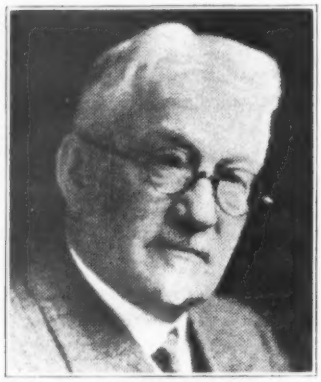
W. W. GRAHAM
Engineer Cincinnati District
American Rolling Mill Co.
Middletown, Ohio

R. E. WALKER
Engineer Tulsa Office
American Rolling Mill Co.
Middletown, Ohio

H. S. JOHNSON
V. P. in Charge of Sales
American Hoist & Derrick Co.
St. Paul, Minn.

H. G. CHAPMAN
President
The American Well Works
Aurora, Ill.

R. B. CHAPMAN
Asst. Secy. and Asst. Treas.
The American Well Works
Aurora, Ill.

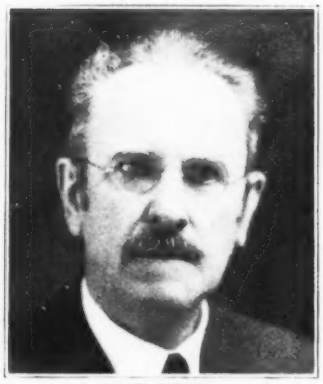


R. D. MAHAFFEY
Vice-Pres. and Treas.
The American Well Works
Aurora, Ill.

H. W. SPILLER
Secretary
The American Well Works
Aurora, Ill.

R. W. RUTH
Sales Manager
The American Well Works
Aurora, Ill.

GEORGE L. WIRTZ
Secretary
The Atlas Mineral Products Co. of Pa.
Mertztown, Pa.



M. F. WIRTZ
President
The Atlas Mineral Products Co. of Pa.
Mertztown, Pa.

BEN H. BLACK
Sales Engineer
The Atlas Mineral Products Co. of Pa.
Mertztown, Pa.

C. W. FISHER
Vice-President
Austin Machinery Corp.
Muskegon, Mich.

O. A. SEYFERTH
President
Austin Machinery Corp.
Muskegon, Mich.

FREDERICK H. BRADFORD
President
Automatic Primer Company
Chicago

ERIC W. BACHARACH
President
E. W. Bacharach & Company
Kansas City, Mo.

C. W. WRIGHT
President
Badger Meter Manufacturing Co.
Milwaukee, Wis.

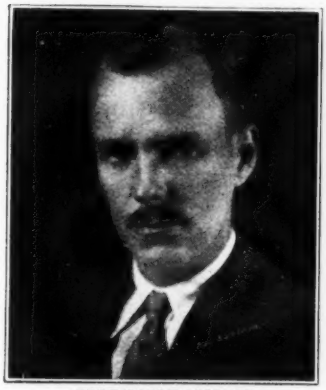
E. M. KRUEGER
Chief Engineer
Badger Meter Manufacturing Co.
Milwaukee, Wis.

J. C. MILLER
Research Engineer
Badger Meter Manufacturing Co.
Milwaukee, Wis.

LUKE L. BALLARD
Vice-Pres. and Genl. Sales Mgr.
Badger Meter Manufacturing Co.
Milwaukee, Wis.

H. BUCHHOLZ
Secretary-Treasurer
Badger Meter Manufacturing Co.
Milwaukee, Wis.

B. E. LINDSTROM
Chicago Dist. Mgr. of Sales
Barber-Greene
Chicago



MORGAN RAMSAY
Sales Manager
Bay City Shovels, Inc.
Bay City, Mich.

ARTHUR W. BLAKE
President and Manager
W. L. Blake & Company
Portland, Maine

WILLIAM T. BIRCH
President
Birch Manufacturing Co.
Chicago

JAMES ASTON
Consulting Metallurgist
A. M. Byers Company
Pittsburgh, Pa.

THOMAS F. WOLFE
Research Engineer
Cast Iron Pipe Association
Chicago

DONALD M. CLARK
Secretary and Sales Mgr.
H. W. Clark Company
Mattoon, Ill.

HORACE W. CLARK
President and Genl. Manager
H. W. Clark Company
Mattoon, Ill.

K. W. CLARK
Treasurer and Plant Mgr.
H. W. Clark Company
Mattoon, Ill.

EDWARD S. DEAN
Eastern Representative
H. W. Clark Company
Mattoon, Ill.

H. POMEROY CLARK
Sales Representative
H. W. Clark Company
Mattoon, Ill.

JOHN V. SCHAEFER
President
Cement Gun Construction Company
Chicago

GEO. T. HORTON
President
Chicago Bridge & Iron Works
Chicago

C. M. LADD
Contracting Engineer
Chicago Bridge & Iron Works
Chicago

CARL H. SCHEMAN
Genl. Mgr. Horton Steel Works, Ltd.
Chicago Bridge & Iron Works
Chicago

MERLE J. TREES
Vice-President
Chicago Bridge & Iron Works
Chicago

C. D. FLEMING
Vice-President
The Cleveland Tractor Co.
Cleveland, Ohio

H. E. ORR
Advertising Manager
The Cleveland Tractor Co.
Cleveland, Ohio

ALLAN J. COLEMAN
President
Allan J. Coleman
Chicago

WM. R. ANGELL
President
Continental Motors Corp.
Detroit, Mich.

L. C. KANITZ
Genl. Sales Manager
Continental Motors Corp.
Detroit, Mich.

I. I. SOLZMAN
Manager
Corken Pump & Machinery Co.
Tulsa, Okla.

F. W. Du BOIS
Vice-President
Dalley & DuBois, Inc.
Detroit, Mich.

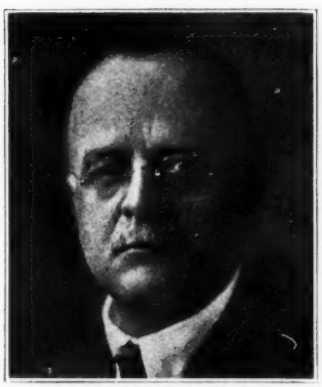
EDWARD DARLING
President
Darling Brothers, Ltd.
Montreal

A. F. BARRON
Chicago District Manager
Dayton-Dowd Co. & Simplex Valve
& Meter Co.

JOHN V. N. DORR
President
The Dorr Company
New York

FRANK BACHMANN
Mgr. Sanitary Engr. Dept.
The Dorr Company
New York

J. D. EVANS
President
Evans Tractor & Equipment Co.
Rapid City, So. Dak.



C. ROBERT CHURCHILL
President
Electric Appliance Company
New Orleans, La.

F. W. GARTNER
President
F. W. Gartner Company
Houston, Texas

P. D. BOWLER
Vice-President
Fairbanks, Morse Company
Chicago

J. A. MANLEY
Vice-President in Charge of Sales
Fairbanks, Morse Company
Chicago

M. B. MAC NEILLE
Mgr. Pump Division
Fairbanks, Morse Company
Chicago

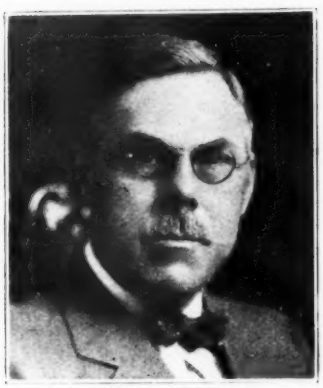
EDWIN H. FORD
President
Ford Meter Box Co.
Wabash, Ind.

RICHARD V. FORD
Eastern Representative
Ford Meter Box Co.
Wabash, Ind.

JOHN L. FORD
Sales Manager
Ford Meter Box Co.
Wabash, Ind.

WILBUR E. FORD
Factory Manager
Ford Meter Box Co.
Wabash, Ind.

T. W. McNAMEE
Secy.-Treas.
Ford Meter Box Co.
Wabash, Ind.

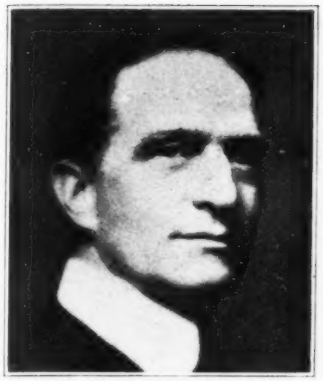


W. A. OLEN
President and Genl. Mgr.
Four Wheel Drive Auto Co.
Clintonville, Wis.

R. H. SCHMIDT
General Sales Manager
Four Wheel Drive Auto Co.
Clintonville, Wis.

M. C. GRIFFIN
"Griff the Pump Man"
Toledo, Ohio

J. M. BEATTY
Mgr. Water Works Sales Dept.
The Hardware & Supply Co.
Akron, Ohio

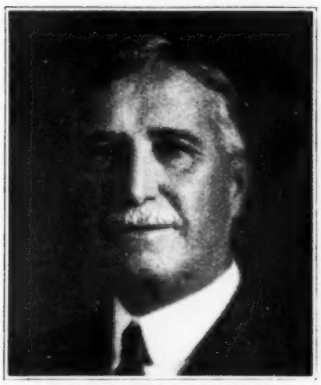


E. H. HOOKER
President
Hooker Electro Chemical Company
New York

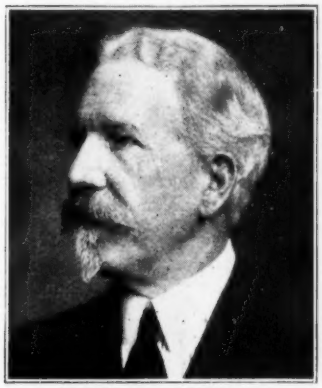
ROY E. NELSON
Vice-Pres. and Genl. Mgr.
Howard-Cooper Corp.
Portland, Ore.

JOSEPH H. COX
Vice-Pres. in Charge of Sales
Kimball, Krogh Pump Co., Inc.
Los Angeles, Calif.

L. W. GLASER
Specialty Sales Mgr.
Littleford Bros.
Cincinnati Ohio

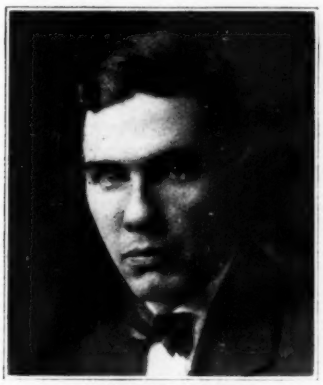


FREDERICK P. BOWDEN
President
Lord & Burnham Co.
Irvington, N. Y.



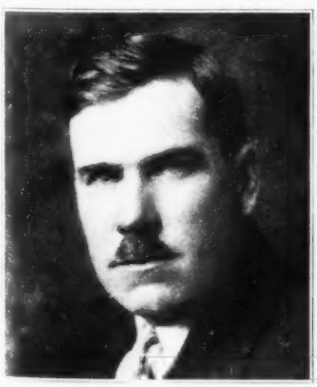
JAMES H. CALDWELL
Chairman of Directors
The Ludlow Valve Mfg. Co.
Troy, New York

WILLIAM H. LOLLEY
President
The Ludlow Valve Mfg. Co.
Troy, New York



J. FRED McCARTHY
McCarthy Well Company
St. Paul, Minn.

W. B. REINICK
McCarthy Well Company
St. Paul, Minn.



E. J. McCARTHY
McCarthy Well Company
St. Paul, Minn.

A. M. SHENK
Pres. & Genl. Manager
McEverlast, Inc.
Los Angeles, Calif.

CLARENCE E. SILVA
Advertising Manager
The Marion Steam Shovel Co.
Marion, Ohio

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President
Mabbs Hydraulic Packing Co.
Chicago

JOHN A. KIENLE
Vice-Pres. in Charge of Sales
The Mathieson Alkali Works, Inc.
New York

R. J. QUINN
Asst. Manager of Sales
The Mathieson Alkali Works, Inc.
New York

C. E. HAGUE
Cleveland District Representative
Michigan Valve & Fdry. Co., Detroit
Dayton-Dowd Company, Quincy, Ill.

ELDON S. CLARK
Engineer
Michigan Valve & Fdry. Co.
Detroit, Mich.

W. H. DAY
Vice Pres. and Genl. Mgr.
Pomona Pump Company
Pomona, Calif.

JAMES E. WALSH
Owner & Genl. Mgr.
Power Plant Supply Co.
Detroit, Mich.

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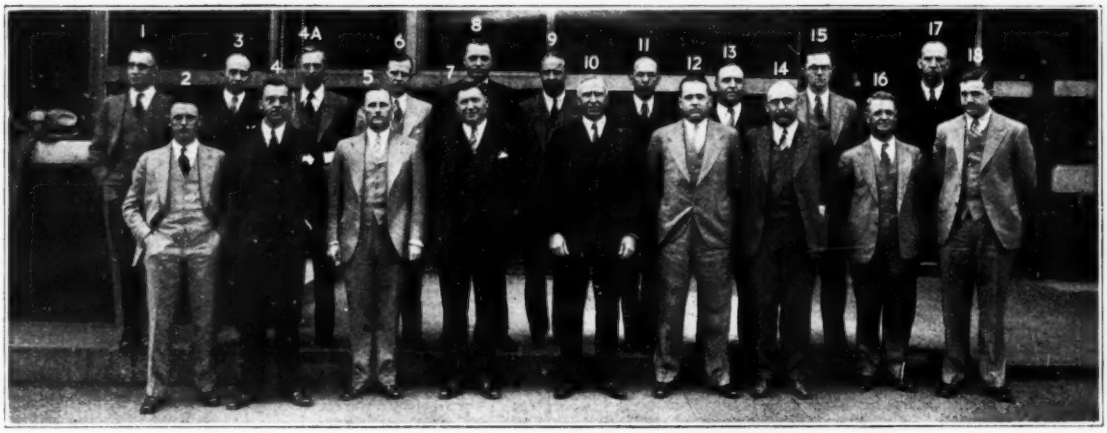
Vice-President
Joseph G. Pollard Co., Inc.
Brooklyn, N. Y.

A. R. PANNELL
President
A. R. Pannell Machinery Co.
Oklahoma City, Okla.

F. R. SCHOEN
President
Pacific Hoist & Derrick Co.
Seattle, Wash.

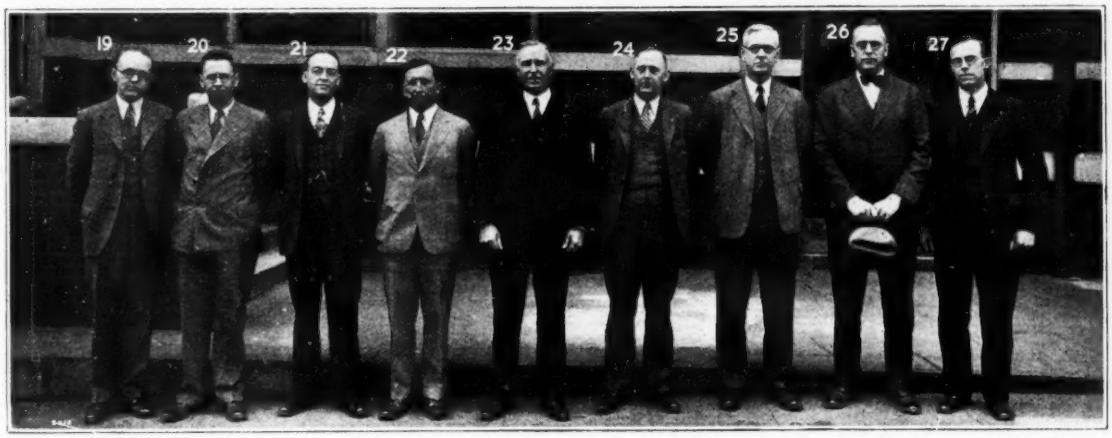
E. G. KOYL
Manager
Water Equipment, Ltd.
Toronto

G. C. PHILLIPS
President and Genl. Mgr.
G. C. Phillips Tractor Co., Inc.
Birmingham, Ala.



McWANE CAST IRON PIPE CO. PERSONNEL

1. Arthur K. Akers, Publicity; 2. J. M. Faunce, Sales Repr., Birmingham; 3. W. P. Cox, General Sales Manager; 4. Wesley Westmoreland, Jr., Southwestern Sales Manager, Dallas; 4. A. P. M. Lovell, Auditor; 5. B. F. Crabbe, Publicity Dept.; 6. A. T. McWane, Treasurer; 7. J. D. Sample, Vice-Pres. and General Manager; 8. P. W. Allen, Eastern Sales Manager, Philadelphia; 9. M. M. Grant, Jr., Southern Sales Manager, Birmingham; 10. J. R. McWane, President; 11. W. Lee Roueche, Works Manager, Birmingham; 12. C. H. Allen, Sales Engineer, Chicago; 13. Shirley W. Harris, Manager Chicago Office; 14. A. W. Claussen, Asst. to Works Manager; 15. S. C. Orr, Sales Representative, Dallas; 16. George Williamson, Research Engineer; 17. William McWane, Asst. to President; 18. L. J. Wilkinson, Sales Repr., Philadelphia.



PACIFIC STATES CAST IRON PIPE CO. PERSONNEL

19. Dana Kepner, Manager Denver Office; 20. Clyde A. Simpson, Sales Repr., Salt Lake City; 21. Walter Adams, Sales Promotion, Provo, Utah; 22. Geo. E. Sibbett, Gen. Mgr., Provo Plants; 23. J. R. McWane, President; 24. J. L. Hill, Sales Manager; 25. Robert Disher, Manager Portland Office; 26. V. H. Doyle, Manager San Francisco Office; 27. H. M. Dudley, Mgr., Los Angeles Office.

O. A. NELSON
Manager New York Office
National Cast Iron Pipe Co.
New York

A. M. AVERY
Manager Dallas Office
National Cast Iron Pipe Co.
Dallas, Texas

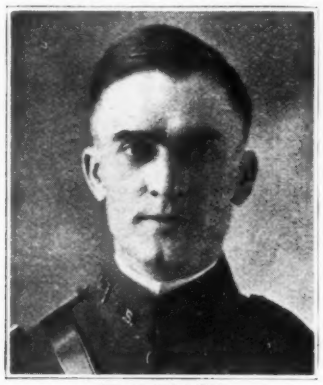
PAUL A. IVY
Vice-President
National Cast Iron Pipe Co.
Birmingham, Ala.

E. E. LINTHICUM
President
National Cast Iron Pipe Co.
Birmingham, Ala.

JOS. W. IVY
Manager Kansas City Office
National Cast Iron Pipe Co.
Kansas City, Mo.

M. T. BRAMMAN
Manager Houston Office
National Cast Iron Pipe Co.
Houston, Texas

RALPH R. SILVER
Advertising Counselor
National Cast Iron Pipe Co.
Birmingham, Ala.



W. G. BLACK
Asst. Manager Kansas City Office
National Cast Iron Pipe Co.
Kansas City, Mo.

WILLIAM E. CLOW
President
James B. Clow & Sons
Chicago

JOHN McPARTLAND
Special Rep. Cast Iron Pipe & Fdry. Dept.
James B. Clow & Sons
Chicago

W. E. CLOW, JR.
Vice-President
James B. Clow & Sons
Chicago

FRANK J. EGAN
Manager, Chicago
Cast Iron Pipe & Fdry. Dept.
James B. Clow & Sons

WALTER J. O'DAY
Assistant Manager, Chicago
Cast Iron Pipe & Fdry. Dept.
James B. Clow & Sons

KENT S. CLOW
Vice-President
James B. Clow & Sons
Chicago

THE INCREASING USE OF THE TELEPHONE REQUIRES THE EXPENDITURE OF HUNDREDS OF MILLIONS ANNUALLY FOR EXTENSIONS AND IMPROVEMENTS

It keeps faith with your needs

An Advertisement of the American Telephone and Telegraph Company

You have found a constantly growing use for the telephone. You have learned its value in business. You have found it helpful in keeping contact with family and friends. Its increasing use has given the telephone its humanly important place in modern life and requires the expenditure of hundreds of millions annually for extensions and improvements.

In 1929 the Bell System's additions, betterments and replacements, with new manufacturing facilities, meant an expenditure of 633 million dollars. During 1930 this total will be more than 700 millions.

Definite improvements in your service result from a program of this size and kind. They start with the average time required to put in your telephone—which in five years has been cut nearly in half. They range through the other branches of your service, even to calls for distant points—so that all but a very few of them are now completed while you remain at the telephone.

In order to give the most effective, as well as the most economical service, the operation of the Bell System is carried on by 24 Associated Companies, each attuned to the part of the country it serves.

The Bell Laboratories are constantly engaged in telephone research. The Western Electric Company is manufacturing the precision equipment needed by the System. The staff of the American Telephone and Telegraph Company is developing better methods for the use of the operating companies. It is the aim of the Bell System continually to furnish a better telephone service for the nation.

H. W. FORD
District Manager
Pittsburgh-Des Moines Steel Co.
New York

J. E. O'LEARY
Genl. Sales Manager
Pittsburgh-Des Moines Steel Co.
Pittsburgh, Pa.

O. D. DeHART
District Manager
Pittsburgh-Des Moines Steel Co.
Dallas, Texas

H. D. FOWLER
District Manager
Pittsburgh-Des Moines Steel Co.
Seattle, Wash.

H. M. HOWARD
District Manager
Pittsburgh-Des Moines Steel Co.
Atlanta, Ga.

MAXWELL WHITACRE
Mgr. Chicago Office
Pittsburgh-Des Moines Steel Co.
Chicago

E. W. THOMAS, JR.
Chicago Dist. Sales Representative
Reading Iron Company
Reading, Pa.

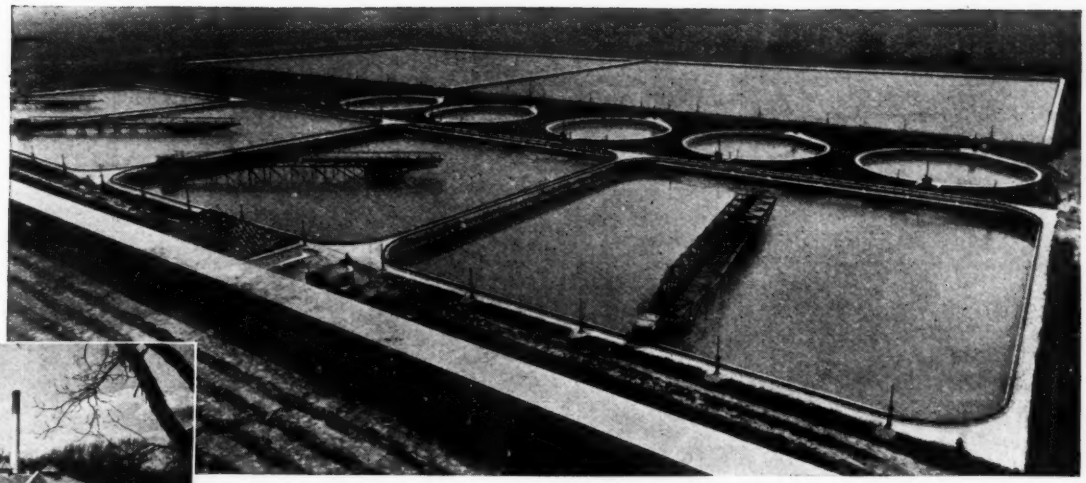
H. F. MATTERN
Genl. Sales Mgr. New York Office
Reading Iron Company
Reading, Pa.

H. S. CARLAND
New York Dist. Sales Representative
Reading Iron Company
Reading, Pa.

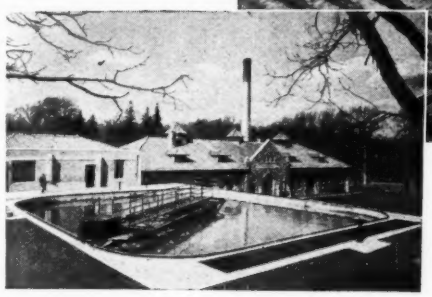
R. B. ANDREWS
Rome Brass & Copper Co., Div.
Revere Copper & Brass, Inc.
Rome, N. Y.

E. I. VAN DOREN
The E. I. Van Doren Companies
Rep. Yeomans Bros. & S. E. T. Valve
Troy, N. Y.

W. A. STANCER
Sales Manager
Whitney Engineering Co.
Tacoma, Wash.



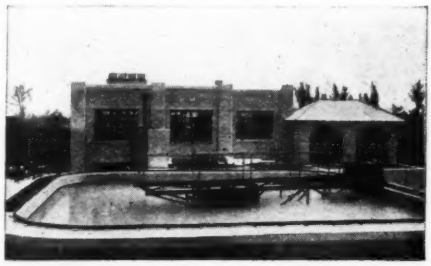
Four Dorr Traction Clarifiers in the Howard Bend Plant, St. Louis.
L. A. Day, Water Commissioner, E. E. Easterday, Designing Engineer



Mamaroneck, N. Y., Alexander Potter, Cons. Engr.

At the A. W. W. A. Convention—

You Will See Dorr Clarifiers in St. Louis' New Water Treatment Plant



Boca Raton, Fla., H. S. R. McCurdy, Cons. Engr.

Miami, Fla., Alvord, Burdick & Howson, Cons. Engrs.

IF you are planning on attending the convention of the American Water Works Association in St. Louis, you will undoubtedly see the Dorr Traction Clarifiers, which are used for primary and secondary sedimentation, in the Howard Bend water treatment plant.

However, it is not necessary to go to St. Louis to see these continuously cleaned sedimentation basins. Visit any recently built or currently building water treatment plant in the U. S. or Canada and you are almost sure to find Dorr Clarifiers on the job. The small illustrations show some of these installations.

Ask our nearest office for a copy of the new edition of our booklet, "Modern Sanitary Engineering Practice"

DORRCO

THE DORR COMPANY

ENGINEERS

247 PARK AVENUE NEW YORK CITY

INVESTIGATION TESTS DESIGN EQUIPMENT

DENVER, COLO.
1009 17th Street

CHICAGO, ILL.
333 North Michigan Avenue

LOS ANGELES, CAL.
108 West 6th Street

WILKES BARRE, PA.
Miners Bank Building

ATLANTA, GA.
1503 Candler Building

TORONTO, ONT.
330 Bay St.

MELBOURNE, AUSTRALIA
Crossle & Duff Pty., Ltd., 360 Collins Street

TOKYO, JAPAN
Andrews & George Co., Inc., Central P. O. Box F-23

LONDON
The Dorr Company, Ltd.
Abford House, Wilon Rd., S. W. 1

BERLIN
Dorr Gesellschaft m. b. H.
Kielganstr, 1 W. 62

PARIS
Societe Dorr et Cie
26 Rue de la Pepiniere

JOHANNESBURG, S. A.
E. L. Bateman
Locarno House.

C. F. WALLACE
Vice-President
Wallace & Tiernan Co., Inc.
Newark, N. J.

M. F. TIERNAN
President
Wallace & Tiernan Co., Inc.
Newark, N. J.

A. J. DUAEI
Western Sales Manager
W-K-M Company
Houston, Texas

R. R. NORRIS
Mgr. Sales Industrial Div.
W-K-M Company
Houston, Texas

E. L. SCHWANHAUSSER
Mgr. Buffalo Works
Worthington Pump & Machinery Corp.
New York

S. NICKERSON
Meter Representative
Worthington Pump & Machinery Corp.
Kansas City, Mo.

H. J. MEEKER
Manager, Public Works
Centrifugal Sales Dept.
Worthington Pump & Machinery Corp.

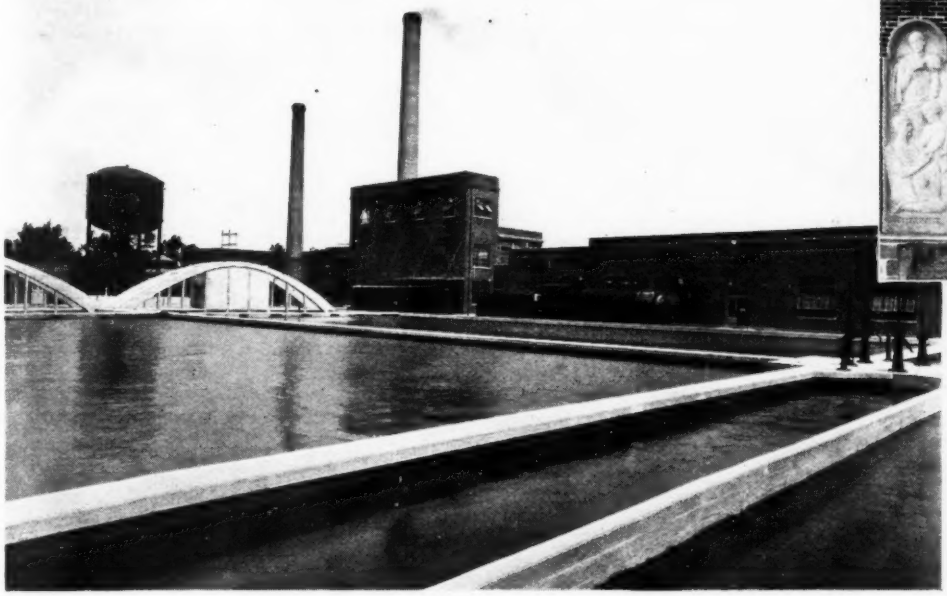
GEORGE H. CARR
Meter Representative
Worthington Pump & Machinery Corp.
Chicago, Ill.

H. P. MATTE
Manager, Meter Division
Worthington Pump & Machinery Corp.
Harrison, N. J.

R. D. HALL
Manager, Water Works Sales
Worthington Pump & Machinery Corp.
Harrison, N. J.

A. H. BORCHARDT
Acting Mgr., Centrifugal Sales Div.
Worthington Pump & Machinery Corp.
Harrison, N. J.

Plan Now To Give Your City Soft Water



Architectural beauty typifies benefits brought by pure, soft water to the health and happiness of citizens of Springfield, Illinois. This waterworks plant is the first and largest in Illinois to do, in one operation, these four things: 1. Filter the water; 2. Soften the water; 3. Remove the iron; 4. Recarbonate the water.

Plant designed by Burns & McDonnell Engineering Co., Consulting Engineers, Kansas City-Los Angeles.

OF all municipal improvements none brings greater benefits--both from the standpoint of a city's investment and the health and happiness of its citizens--than plenty of pure, soft water.

The benefits of soft water are community-wide. The rapid increase in the number of municipal water softening plants is evidence of the wide recognition among superintendents, city officials and the public, that soft water is a necessary civic asset.

Nothing arouses civic pride like a supply of clear, sparkling water--free from odors, taste and bacteria. It is additional good policy for the water board to typify these desirable characteristics by erecting attractive as well as practical structures.

Cities operating filtration plants where the water is hard, would profit greatly by adding a softening plant at slight extra cost. Filtration plants now being designed should provide for softening as well as for purification. If the carbonates are high enough to justify a lime treatment, the lime will serve as a purifying as well as a softening agent, for lime is a most effective germicide.

When soft water is available, cities can attract new industries by assuring them at least 10% annual reduction in operating costs.

For every municipal dollar invested for water softening, citizens save many. The annual saving in soap alone will average three times the annual cost of softening the water with lime. Additional savings would be: decreased fuel bills of 5 to 10% due to scale-free water; reduced repairs to heater coils and replacement of plumbing fixtures; lowered laundry bills and cleaning costs for removing iron stains.

The National Lime Association offers its cooperation in furnishing interested officials full information.

Rely on LIME *-tested by time*

NATIONAL LIME ASSOCIATION

An organization of leading lime manufacturers formed to encourage a better appreciation of the economic value of lime in all its uses.

143-A

711 PHILLIPS BUILDING « WASHINGTON, D.C.

DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group

Badger Meter Announces a Record Year at Sales Conference

The accomplishments of the Badger Meter Manufacturing Company during 1929 were the keynotes of the annual sales meeting held recently in the home office at Milwaukee, Wis. Officials of the company pointed out the strides made during the past year, and stated that 1929 was the biggest in the history of the company, which is now in its 26th year. This splendid showing was attributed to the increased manufacturing space and facilities, additional sales representatives, and a more complete line of water meters.

During the last few years, the company made an addition to the plant which covered a half block square, giving it an increased floor space of 45,000 sq. ft. in the manufacturing and assembling buildings. Besides this addition, a new brass foundry was constructed, having 15,000 sq. ft. of floor space and equipped in the newest and latest type of machines.

New models have been added to the Badger line during the past year, standards of the American Water Works and New England Water Works Associations have been fully complied with in redesigning, and all changes were made to increase efficiency and serviceability, details concerning which were pointed out and discussed at the meeting.

It was reported that the company's engineering staff and research laboratory staff have been added to considerably and a definite program has been planned to keep the products abreast of the requirements of the field, and to introduce such new meters as are necessary from time to time to increase meter efficiency. Two developments of the past year were an automatic batch water meter for accurately measuring water on central concrete mixing plants, and a companion concrete batch mix meter for installation on portable concrete mixers. The industrial meter division has been expanded, and an electric alarm register set-up for practical application for measuring equipment as applied to water softeners has also been developed.

Expect Ex-President Coolidge at Fairbanks-Morse Pageant

The hundredth anniversary of the founding of Fairbanks-Morse & Company will be commemorated in a three-day celebration starting on July 4th in the historical city of St. Johnsbury, Vt.

Ex-President Coolidge was at one time a student at the St. Johnsbury Academy, which was sponsored and supported by Thaddeus Fairbanks, and, according to announcement, it is expected that he and Mrs. Coolidge will be guests of honor at the celebration.

Thaddeus Fairbanks, known as the "father of modern weighing," invented the platform scales one hundred years ago, and with his brothers started their manufacturing business with an investment of $4,000.

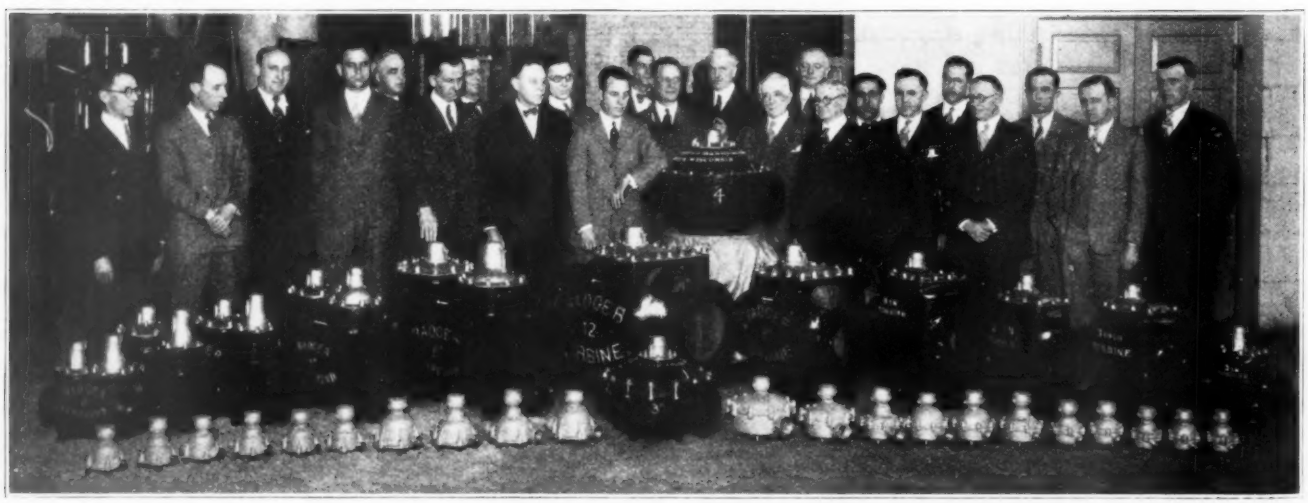
The principal feature of the program, as announced, will be an historical pageant depicting the progress during the last century in the evolution of the modern weighing machine and its influence upon human welfare and world commerce.

Tube-Turns Appoints Distributors

Appointment of new distributors is announced by Tube-Turns, Inc., Louisville, Ky., manufacturers and marketers of seamless, short radius forged fittings for pipe welding, as follows:

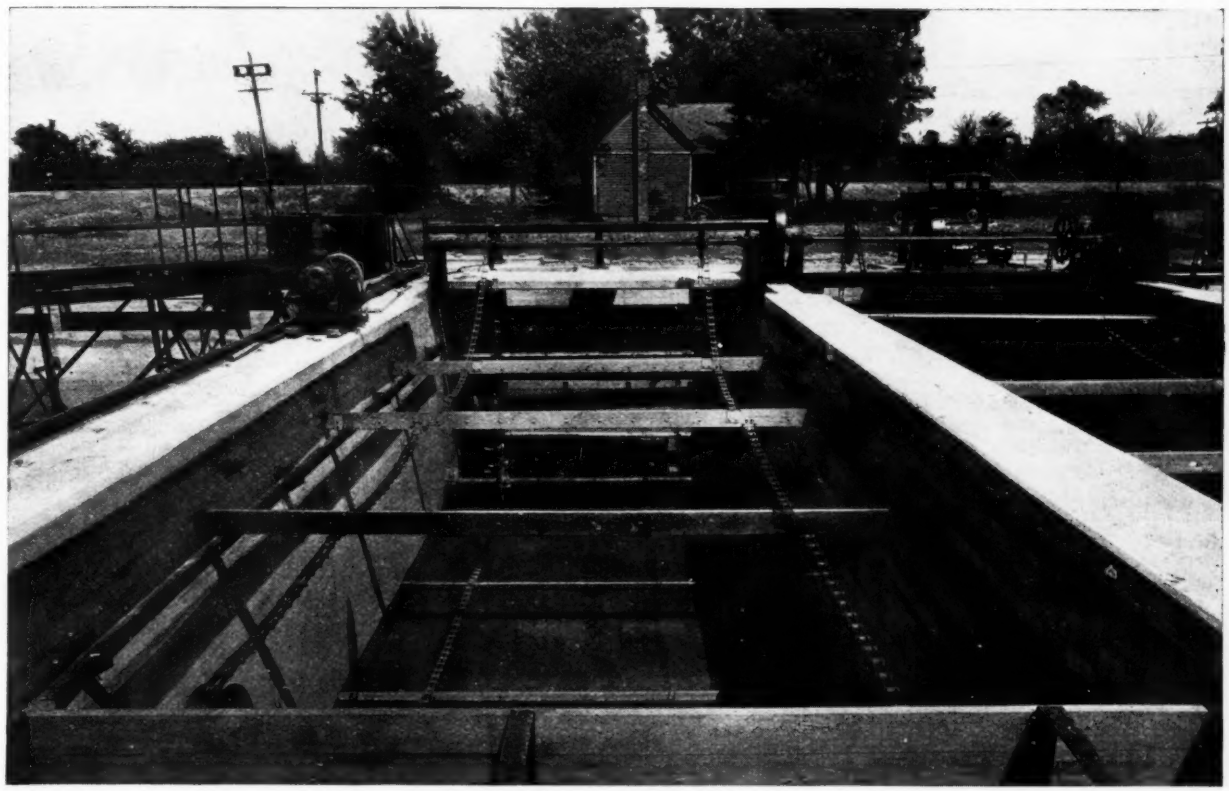
The Grinnell Company, at Charlotte, N. C., for North and South Carolina and Georgia; Ebbert & Kirkman Company, Inc., of Birmingham, Ala., for Alabama; the B. Hoffmann Manufacturing Company, of Milwaukee, for Milwaukee and adjacent territory; the United Pipe & Supply Company, of Charleston, W. Va., for Charleston and adjacent territory; the Vulcan Copper & Supply Company of Cincinnati, for Cincinnati and adjacent territory, and Hedley & Voisinet of Buffalo, for Buffalo and surrounding territory.

The Paradon Manufacturing Co. of Arlington, N. J., announces the appointment of the Sanitary Appliance Co., Inc., 308 Hughes St., Houston, Tex., as representatives for the sale and service of Paradon chlorinators and allied products in the state of Texas.



Representatives and Officials of the Badger Meter Manufacturing Company, Milwaukee, Wis.

Link-Belt STRAIGHTLINE Collectors for Sludge, Grit and Scum



Springfield, Ill. Showing two of three Primary Settling Tanks with Straightline Collectors, at the Activated Sludge Plant.

STRAIGHTLINE collection, with its straight working pulls, means that the major stresses are tensile stresses. Tension members may have very large factors of safety without being unwieldy, and large factors of safety insure uninterrupted operation through a wide range of conditions.

STRAIGHTLINE operation is of proved reliability. Link-Belt units of this type have been in operation for more than a decade in coal-washers where the loads are heavy and the materials abrasive—the original chains are still in use! Modern Link-Belt units will last even longer. Designs have been improved, and important new features added so that the Link-Belt Company feels every confidence in offering STRAIGHTLINE to the Sanitary Engineering profession.

Turn to Link-Belt for sewage treatment plant equipment — Collectors, Fine Screens, Mechanically Cleaned Bar Screens and Mechanical Aerators. Send for new Book No. 642.

LINK-BELT COMPANY

PHILADELPHIA, 2045 W. Hunting Park Ave. CHICAGO, 300 W. Pershing Road

3905

LINK-BELT

SEWAGE TREATMENT PLANT EQUIPMENT

How Times Have Changed!

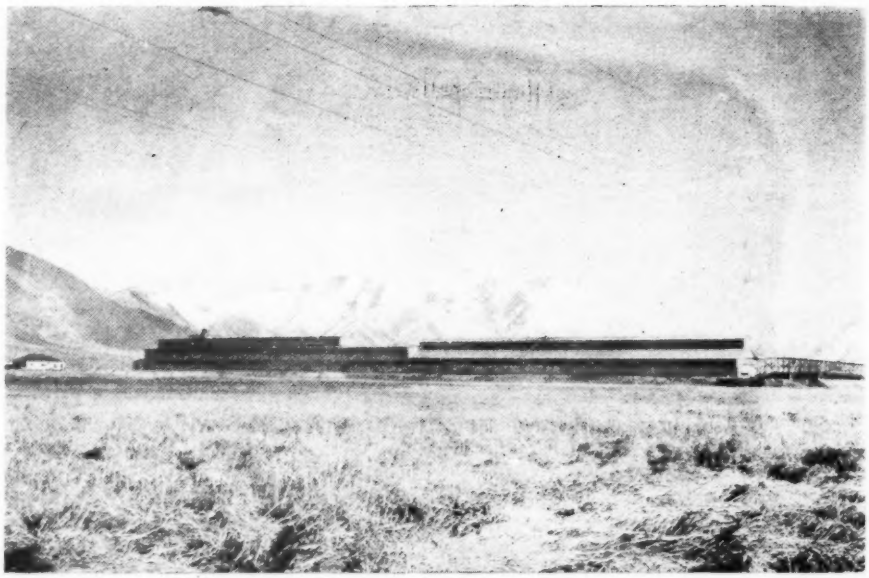
In speaking of the early days of the McWane family in the foundry business, J. R. McWane, now president of the McWane Cast Iron Pipe Company of Birmingham, and of the Pacific States Cast Iron Pipe Company of Provo, Utah, relates:

"When I was a small boy, at Wytheville, Va., my father gratified the ambition he had always cherished to go into the foundry business. He had $300 in cash with which he purchased a second-hand boiler for a cupola, and a second-hand horse power to drive the blower. He made his own blower, using wood for the shell and sheet iron for blades. It made as much noise as a threshing machine.

"A small blacksmith shop in our back yard was converted into a foundry. Every Saturday afternoon Bill Holly, a negro teamster, would bring his two horses and a crippled mule and hitch up to the horse power for the weekly 'heat.' On the signal that all was ready, Bill would mount the platform in the center, crack his whip, and the noise would start. The tonnage made was usually about 1,000 lb., mostly plow castings.

"The excitement of the melt lasted about two hours. Father, the pattern-maker, carried one end of the ladle shank, and my oldest brother, the molder, carried the other end. No payroll and no overhead, consequently success!

"Later father bought a small engine and a little machinery and moved uptown to a new location. Here I learned the molder's trade and acquired my love for the foundry business. My father taught me, by precept and example, to depend on my own resources; and for this as well as other lessons taught by him, I shall always be most grateful."



Provo, Utah, Plant of Pacific States Cast Iron Pipe Co., Where McWane Pipe for the Territory West of the Rockies Is Produced

New Office Building of McWane Cast Iron Pipe Co., 12th Ave. and Vanderbilt Rd., Birmingham, Ala.

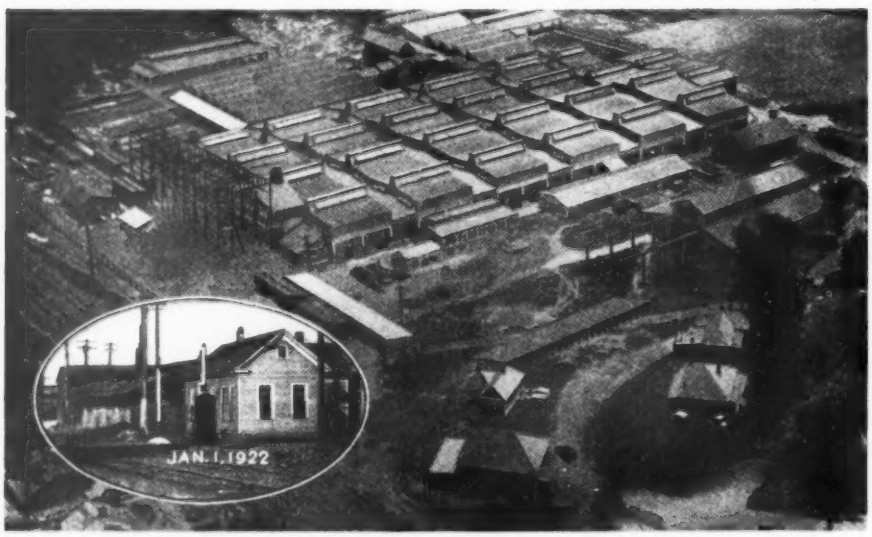
The real beginning of the McWane Cast Iron Pipe Company, which has recently completed the handsome new office building shown on this page, was in 1921 when, under the direction of its president, J. R. McWane, cast iron pipe was manufactured in very small sizes in the rented foundry pictured in the inset of the view of the Birmingham plant. J. D. Sample was then vice-president, general manager, secretary and treasurer.

The company attributes its success and rapid growth to the many increasing demands for small cast iron pipe in which it has specialized. In 1922 A. T. McWane, younger brother of the president, joined the company as secretary-treasurer, and soon after that date a new foundry was built especially for the McWane processes of casting pipe in small sizes and horizontally in green sand molds with green sand cores.

With the growth of the business, the two salesmen, one located in Philadelphia and one in Los Angeles, had to have reinforcements, and offices were opened in Dallas and in Chicago. But, the high freight rates to the Rocky Mountain region and west, made shipments from Birmingham well-nigh prohibitive, so another cast iron foundry seemed the answer to this marketing problem. This was the reason for the organization of the Pacific States Cast Iron Pipe Company, jointly with the Columbia Steel Corporation, which was already established at Provo, Utah. This step was taken in 1926, resulting in the opening of offices in San Francisco, Portland, Salt Lake City and Denver.

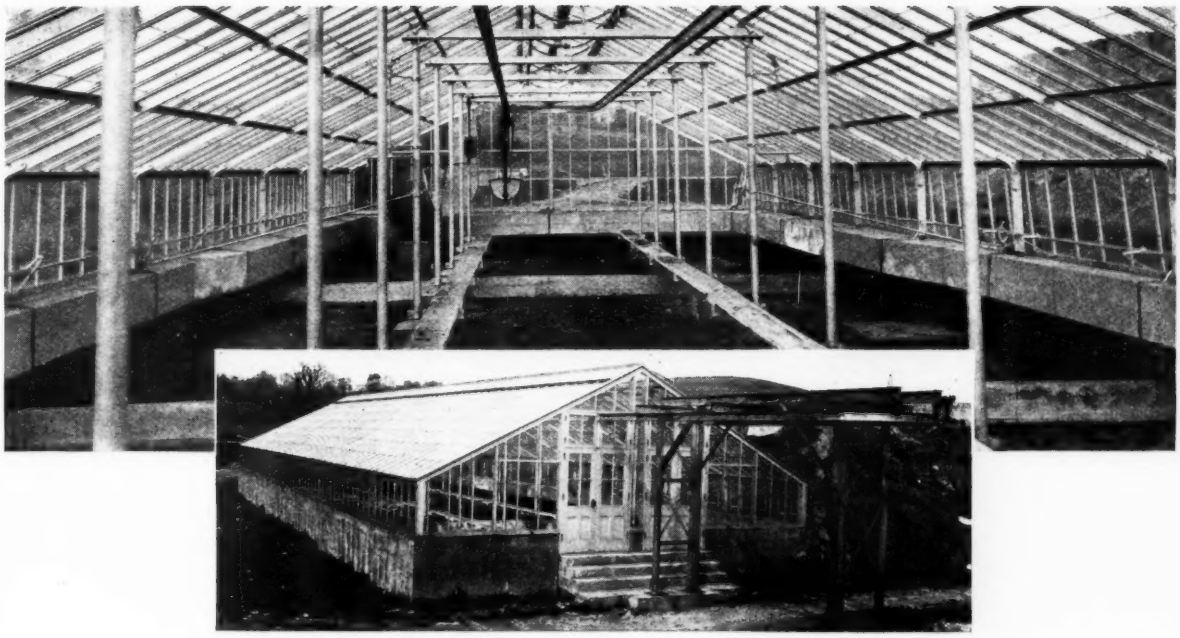
The next important step in the development of this organization was to find a way to turn the hand processes in use into mechanical processes, in the words of one of the officials it was: "mechanize or paralyze." With necessity driving, methods were evolved for making their cast iron pipe by mechanical means instead of by hand, although holding to the same basic principles, and now, it is said, "a literal torrent of pipe pours out from the finishing departments of the plant, day and night.

In 1929 the Columbia Steel Corporation was purchased by the United States Steel Corporation and a deal resulted by which the Pacific States Cast Iron Pipe Company came wholly under McWane ownership.



View of Birmingham Plant of McWane Cast Iron Pipe, with Inset Showing Plant in 1922

Master Construction Glass-Overs for Sludge Beds



The J. N. Chester Engineers, Pittsburgh, Pa.

Facts Concerning The Disposal System At New Lexington, Ohio

The plant is designed to treat an average flow of 500,000 gallons per day, serving a population of 5000. In addition to the one Lord & Burnham Sludge Bed Glass Over for speeding up the drying of the sludge, the equipment consists of the following:

(1) An automatic sewage pumping station.
(2) Coarse Screens.
(3) 4 Imhoff tanks
(4) Dosing tank.
(5) A trickling filter.
(6) A humus tank equipped with Dorr Thickener.
(7) A laboratory and general service building.

The sewer system is strictly sanitary, and consists of more than 20 miles of sewers, ranging in size from 8″ to 18″, all constructed according to the engineers' plans and specifications, simultaneously with the construction of the sewage disposal plant.

The city has passed a sewer rental law whereby each household, industry, and public building, is charged for the services rendered by the sewerage system and sewage disposal plant, thus providing operating funds for this purpose.

The Glass-Over itself, is the latest in design and construction, giving quick drying results and insuring long life to the structure. No other construction has the same proven practicalness and endurance. Send for full particulars.

Lord & Burnham Co.

Sludge Bed Glass-Overs

Graybar Building
New York City

208 South LaSalle Street
Chicago, Ill.

Harbor Commission Building
Toronto, Canada

Branch Offices: Boston, Philadelphia, Irvington, Albany, Denver, Detroit, Cleveland, Kansas City, Buffalo, Greensboro, St. Louis, Montreal, St. Catharines

Although the company is still in its first decade, the second generation is represented by Mr. William McWane, son of the president, who serves as his father's assistant and as secretary of the organization. It is said that courage to disregard precedent, along with a policy of bringing in new blood from outside the cast iron pipe field, which "in its ignorance, did not know that 'it couldn't be done'" contributed to the success of the industry.

American Rolling Mill Sets New Safety Record

The Middletown Works of The American Rolling Mill Co., of Middletown, O., has announced a new Armco plant safety record by completing 1,300,000 man-hours without lost time because of accident.

In 1929, it is stated, that the Middletown plant had thirty-two accidents for the period to date for which they now have two. During the same period in 1929 the company as a whole had eighty-six accidents, which for the 1930 period was reduced to twenty-six.

The record which the Middletown plant holds started Feb. 21, 1930. The Middletown plant includes all operations from open hearth to shipping of the finished sheet.

A new company record was announced recently when the entire organization went eleven days without a lost time accident. The previous record was ten days.

Newby Made Western Manager for Hyatt Roller Bearing

Announcement has been made of the appointment of C. L. Newby as manager of the western division of The Hyatt Roller Bearing Co. of Newark, N. J. His headquarters will continue to be in Chicago, where he formerly served as assistant manager.

Mr. Newby has been associated with the Hyatt company since 1918 as sales engineer on general industrial, oil field, railroad and farm machinery application.

E. A. Doyle Elected Head of American Welding Society

E. A. Doyle, consulting engineer of the Linde Air Products Company, was elected president of the American Welding Society at the annual meeting of the society, held recently.

Lincoln Electric Announces Personnel Changes

Three members of the manufacturing district of the Lincoln Electric Company, Cleveland, O., have been transferred to the welder service division, according to announcement issued by the company.

Mr. John C. Ardagh will be established at the Chicago headquarters in the Monadnock Building, Chicago. Mr. R. A. Kyle has been sent to the New York district, and will be located at 136 Liberty St., New York City. Mr. Robert Newton has gone to Cleveland, and will have his headquarters at the Cleveland factory.

Phoenix Mfg. Co. Purchases Plant from Graver Corp.

In a recent announcement, Mr. Edward N. Gosselin, president of the Phoenix Manufacturing Company of Joliet, states that the steel tank, water treating and steel plate construction business of the Graver Corporation, including the East Chicago plant, has been taken over as a subsidiary company of Phoenix and will be operated as Graver Tank & Manufacturing Corporation. It is stated that plans for addition and improvements are now being made to make the plant one of the most modern in the country.

Branch offices of the new company will be maintained in Chicago, New York, Dallas, St. Louis, San Francisco and other large centers. The general offices will be located at East Chicago, Ind. The officers are: Edward N. Gosselin, president; F. C. Everitt, vice-president and general manager; R. E. Meyer, secretary and treasurer; P. S. Graver, vice-president in charge of sales; W. F. Graver, vice-president; H. S. Graver, vice-president. Other plants of the Phoenix Company are located at Catasauqua, Pa.; Montreal, Canada, and Joliet, Ill.

Union Electric Bought by Cutler-Hammer Co.

Announcement has been made of the purchase of the Union Electric Manufacturing Company by Cutler-Hammer, Inc. This will add to the Cutler-Hammer products a line of drum type control apparatus.

The present factory of Union will be operated as a manufacturing division of Cutler-Hammer, and the branch sales offices and warehouse stocks will be consolidated with those of the purchasing company. Mr. E. F. LeNoir, president of Union, will become a member of the headquarters sales staff of Cutler-Hammer.

Paradon Moves Albany Office

The Paradon Manufacturing Company of Arlington, N. J., announces the removal of their Albany office from 467 Broadway to new and improved quarters at 1 Columbia Place. Announcement states that Mr. Paul M. Nickerson will continue in charge of this office and will handle the sales and service of Paradon chlorinators in Northern New York and Massachusetts.

Singer Kennedy Corporation announces the removal of their offices from 39 West Adams St. to Suite 904, 203 South Dearborn St., Chicago. This company specializes in the building of radial, common, and face brick chimneys; fire brick furnaces and high temperature fire brick work.

H. F. Kneen Promoted

Announcement has recently been made of the advancement of Mr. Harold F. Kneen to plant superintendent of the Lincoln Electric Company of Cleveland, O., manufacturers of "Linc-Weld" motors and "Stable-Arc" welders.

Mr. Kneen is a graduate of Cornell University, where he completed the course in Industrial Engineering and took the degree of Mechanical Engineer. While in college he took varsity letters in football and track for three consecutive years, and was chosen on several all-American teams. He took work in the Cornell graduate school, during which time he coached freshman football. He is a member of Tau Beta Pi, honorary engineering society, and of Chi Psi fraternity.

Previous to Mr. Kneen's connection with the Lincoln Electric Company he held positions in the Indiana Flooring Company, and was heat transfer engineer for the Ingersoll-Rand Company. He joined the Lincoln company just a year ago as assistant plant superintendent. With the announcement of his appointment as superintendent, comes word of the appointment of Mr. C. J. Bowers as production manager of the company's Cleveland plant.

Budd Wheel Company of Philadelphia and Detroit, according to announcement made by their secretary H. A. Coward, state net earnings, after all charges and reserves, to be $413,-613.86 for the first quarter 1930. This is equal, after preferred dividend, to 40c per share on the common stock outstanding and compares with 55c a share earned on the common during the corresponding quarter last year, figures on the same number of shares.

The Brown Instrument Company, Philadelphia, Pa., announces the consolidation of its Chicago sales office and midwestern factory branch in new quarters located at 155 East Superior St., Chicago. The new arrangement will practically double their former space, and a large stock of replacement material will be carried on hand ready for prompt shipment.

Lincoln Electric Company of Cleveland announces the removal of their Baltimore, Md., distributor's office from 432 North Calvert St. to 600 North Calvert St. The change is to provide additional space for a complete stock of arc welding supplies for the Baltimore trade. Mr. T. A. Canty is in charge of the territory. Mr. R. Rude has been made office manager and Mr. C. N. Hilbinger, sales engineer and service manager.

Hooker Electrochemical Company announces the removal of its executive and sales office from 25 Pine St. to the Lincoln Building, 60 East 42nd St., New York City.

Two Ways to Speed Up the Job

"Get a move on, Tony"

"Specify TRIMO *on that order"*

IT'S often a far cry from the man who does the purchasing of tools to the man who uses them. But the purchaser can speed up work just as surely as the foreman on the job by specifying TRIMO where tongs or pipe wrenches are concerned.

In the oil fields where speed and safety mean a big return in dollars and cents, TRIMO is the leading wrench by a wide margin. The same holds true in water works and sewerage jobs. On any pipe wrench job, you will note a big difference with this strongest and safest of pipe wrenches — All Steel TRIMO.

TRIMO
Pipe Wrench

All Steel
Handle Drop Forged
- - Not Cast

Made by **Trimont Mfg. Co., Inc.,** Roxbury (Boston), Mass.

SERVICE EXCHANGE
For
Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives for their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Manufacturer's representative now handling centrifugal pumps would like to secure other lines in water works field. Covers eastern Pennsylvania, south Jersey and Delaware.

Bacteriologist would like to make connection with manufacturer for such work, or as assistant chemist.

Water Works equipment distributor, covering northeastern Indiana, would like to secure represenation of a line of chlorinators.

Manufacturer of non-clogging sewage pumps, both horizontal and vertical, as well as water works pumps suitable for municipalities of 50,000 or 60,000 people, is interested in securing additional sales representation.

Distributors wanted for deep-well turbine pumping unit. Product serves small industrial plants, private estates and farmers.

Manufacturer of water works brass goods would like to make proposition to manufacturers' representatives calling on water works' trade.

District representatives wanted for sanitary engineering specialty used extensively in the water works, sewage and swimming pool fields.

A Michigan distributor, with many year's experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing incrased facilities in this region.

Canadian distributor of equipment for water softening, filtration, sewage purification and pumping is interested in securing exclusive sales rights for kindred equipment in the Dominion.

Manufacturer's representative with 25 years sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory, or both.

Manufacturers' agents representing well known lines of water works equipment desire to secure line of pipe pushers and other similar equipment for California and western Nevada territory.

Distributor covering northern California, having warehouse facilities, would like to secure line of water meters, pipe jacks or pushers, flow meters, and sewage treatment and disposal material and equipment.

Representatives Wanted

Manufacturer of special valve and hydrant lubricant wishes to establish distributing points throughout the country.

Manufacturer of centrifugal pumps for water works, sewage plants, sand and dredging plants, process industry, contractors, etc., desires to secure additional representation. Attractive territory available.

Manufacturer of plows, grade-rippers and scrapers desires representation in Minnesota, Nebraska, North Dakota and Utah.

Manufacturer of street and traffic signs has attractive territory and proposition to offer distributors.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

Manufacturer of air compressors and contractors' tools has number of desirable territories open. Full co-operation will be extended to distributors.

Manufacturer of contractors and builders levels and transits is seeking district sales manager. Exclusive contract given. Excellent territory still available. Backed by national advertising.

Well established manufacturers' representatives wanted to handle sand and gravel pumps and equipment, in key cities, by successful manufacturer of high grade dredging pumps and hydraulic dredging equipment. Give character of equipment now being handled and territory covered.

Manufacturer of hoisting machinery and air compressors has open territory in New York and New England states for aggressive distributor.

Manufacturer of mechanical spreaders for cover material desires representation by organizations covering entire states. Several desirable states are still open. Number of inquiries now on hand for spreaders require immediate follow up.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

Manufacturer of cut to length, easily erected standardized steel highway bridges, for spans up to and including 40 feet, which are sold to highway commissioners and superintendents, has attractive territory open in states south and west of Chicago.

Manufacturer of Transverse Testing Machines desires to build up distribution organization in this country and abroad.

Manufacturer of plows, grade-rippers and scrapers desires representation in Arizona, New Mexico, Arkansas, Kansas and Louisiana.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Attractive territory available for experienced men to handle contractors' labor-saving equipment by old established company. Equipment backed by national advertising.

A manufacturer of paving expansion joints is looking for distributors for northern California territory.

Manufacturer of metal lath, corner beads, channels and reinforcing mesh desires to secure distributors for products in the southwest and middlewest.

Manufacturer of threadless pipe couplings and tees, with rapidly growing business, is seeking additional representatives.